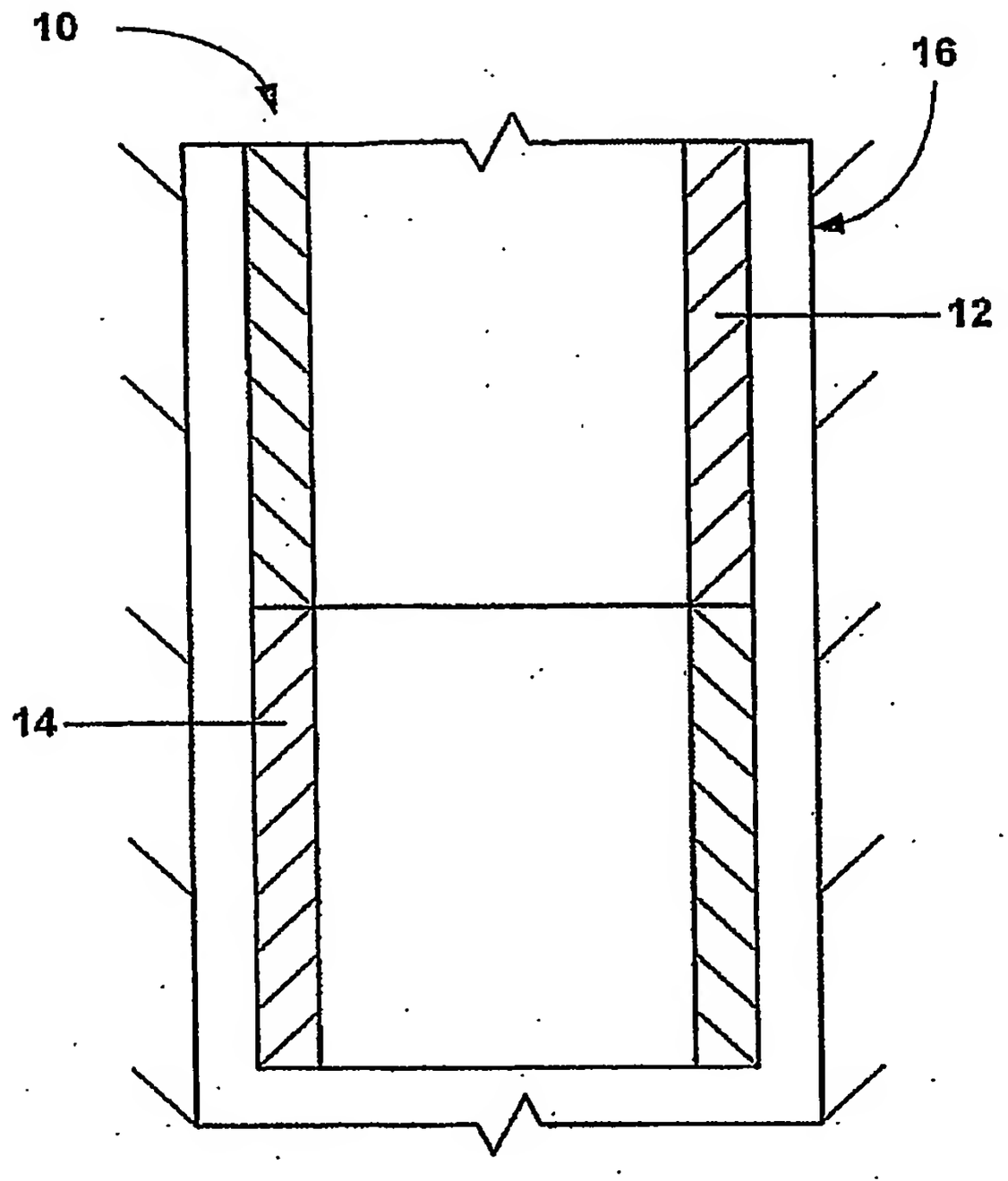


FIG. 1

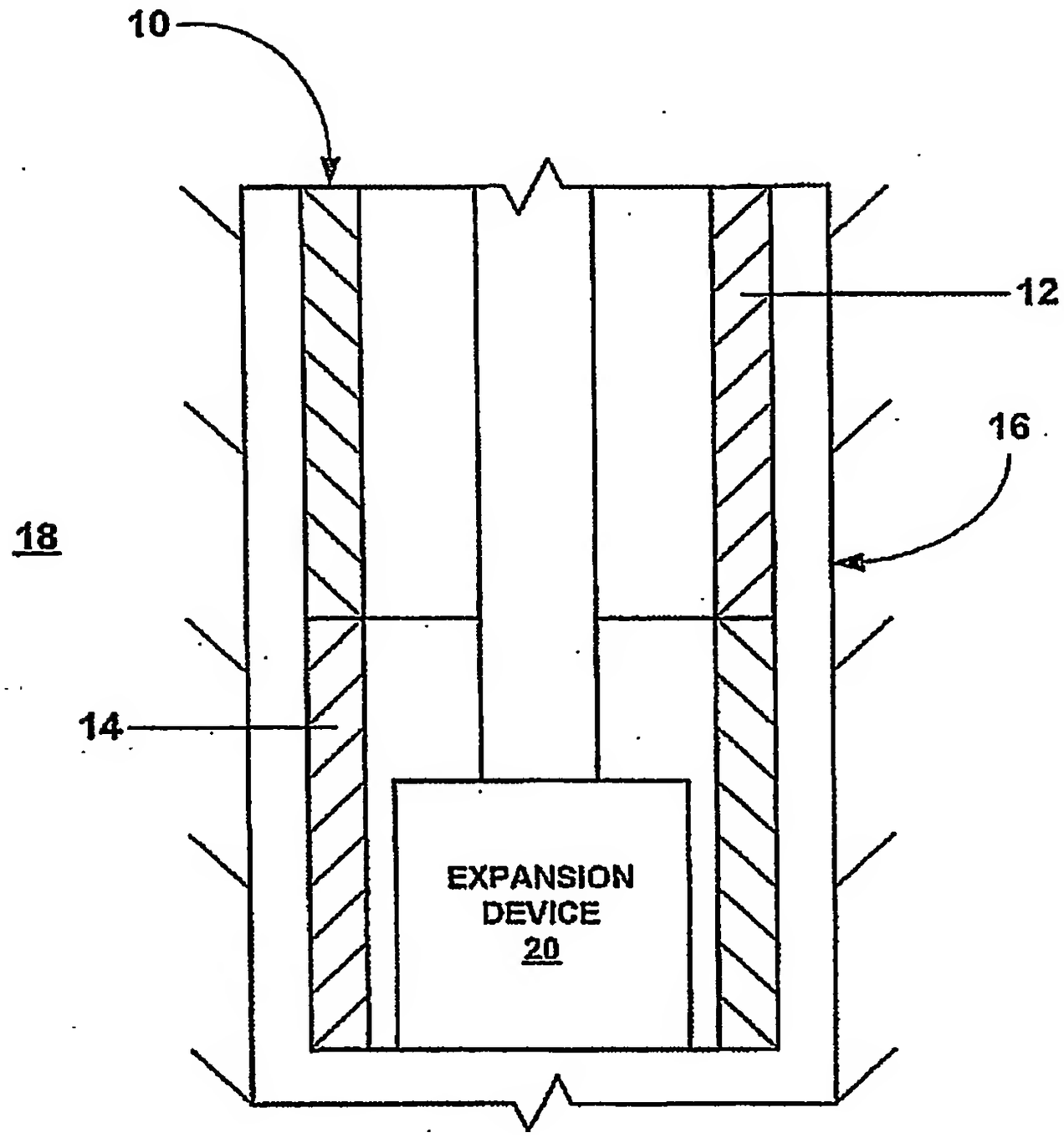


FIG. 2

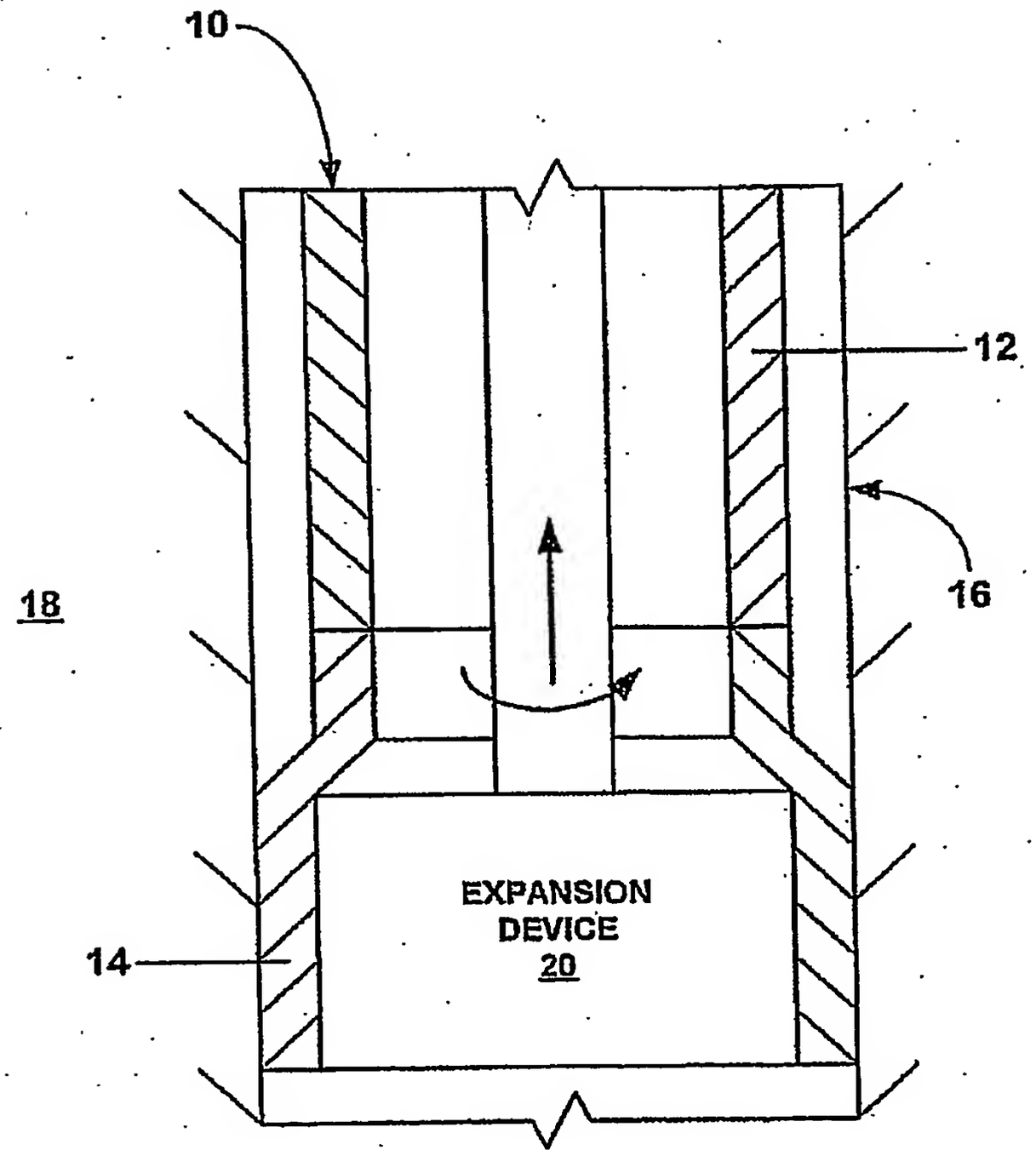


FIG. 3

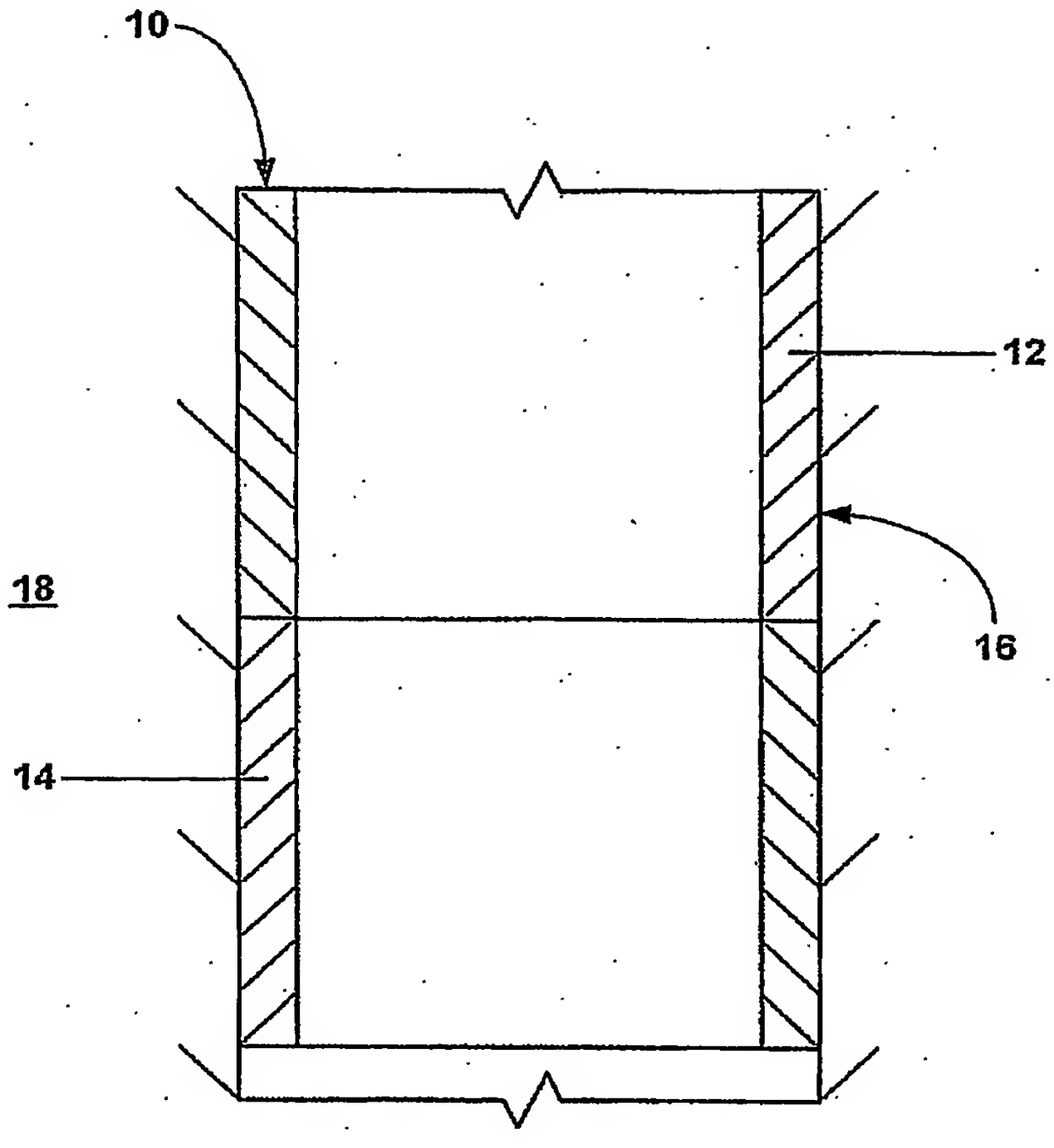


FIG. 4

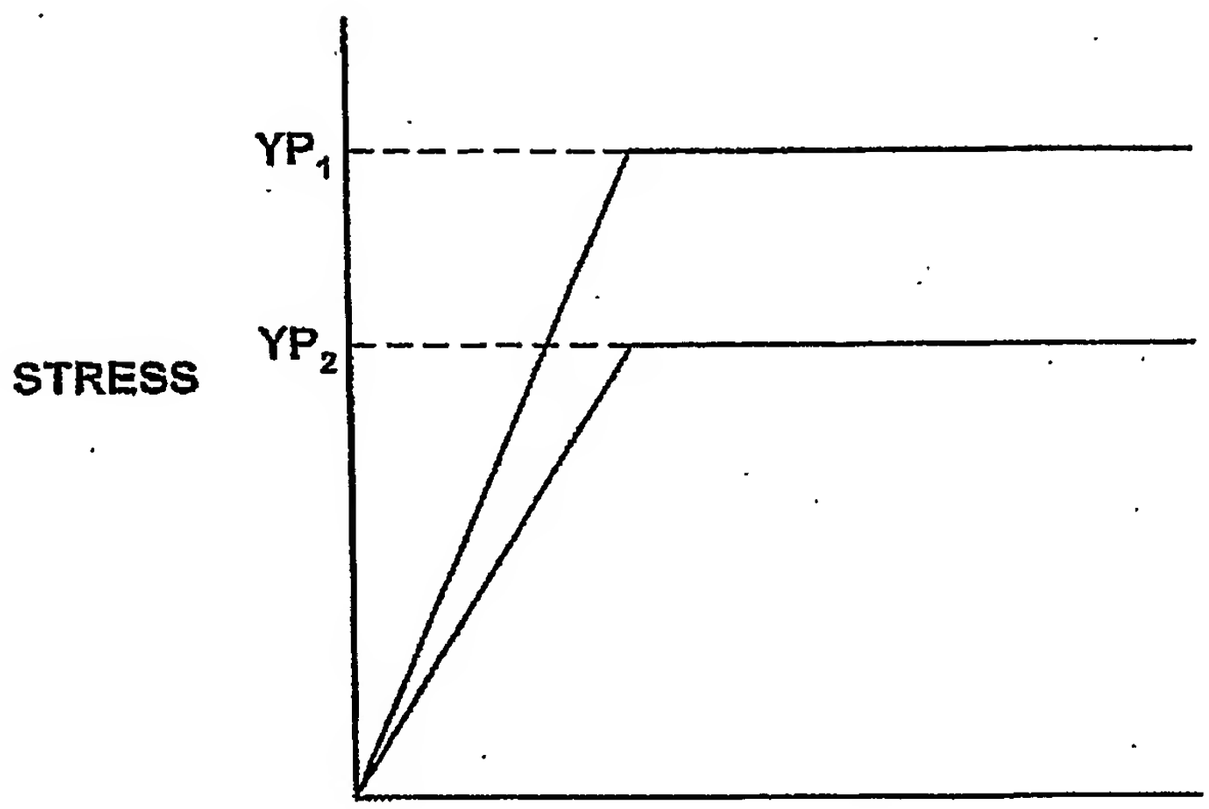

YP1
YP2
STRESS
STRAIN

FIG. 5

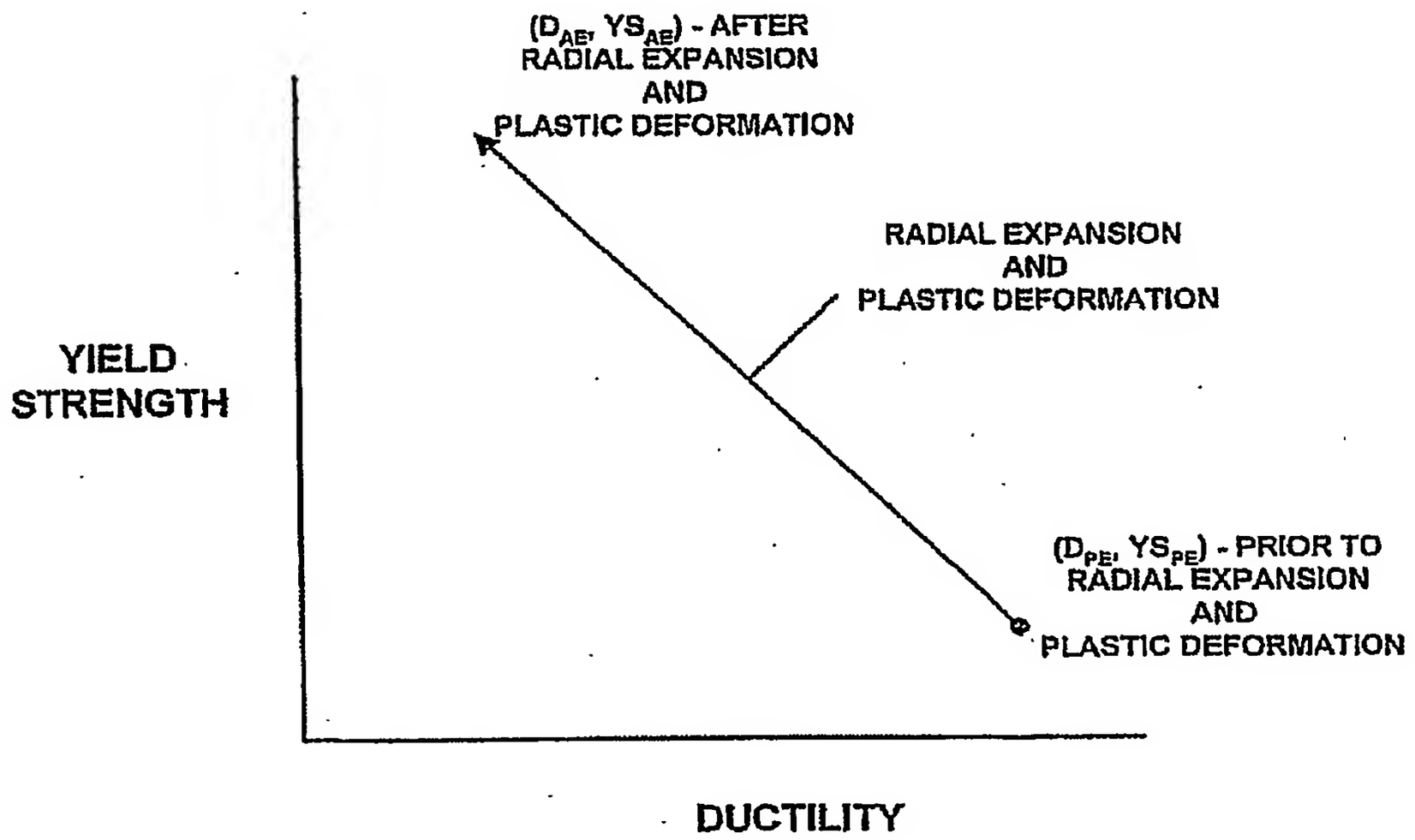

(DAE, YSAE) - AFTER RADIAL EXPANSION AND PLASTIC DEFORMATION
RADIAL EXPANSION AND PLASTIC DEFORMATION
(DPE, YSPE) - PRIOR TO RADIAL EXPANSION AND PLASTIC DEFORMATION
YIELD STRENGTH
DUCTILITY

FIG. 6

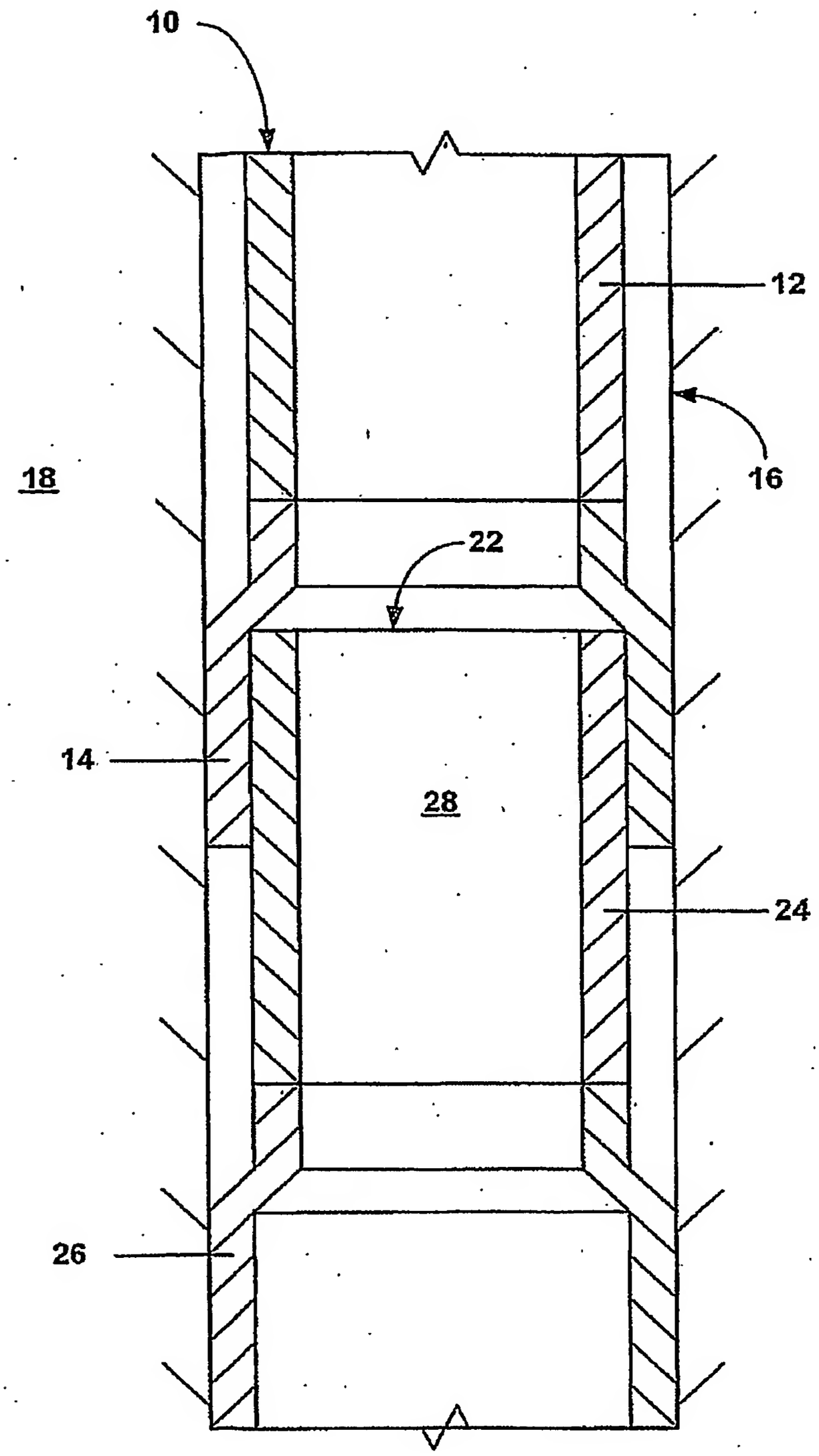


FIG. 7

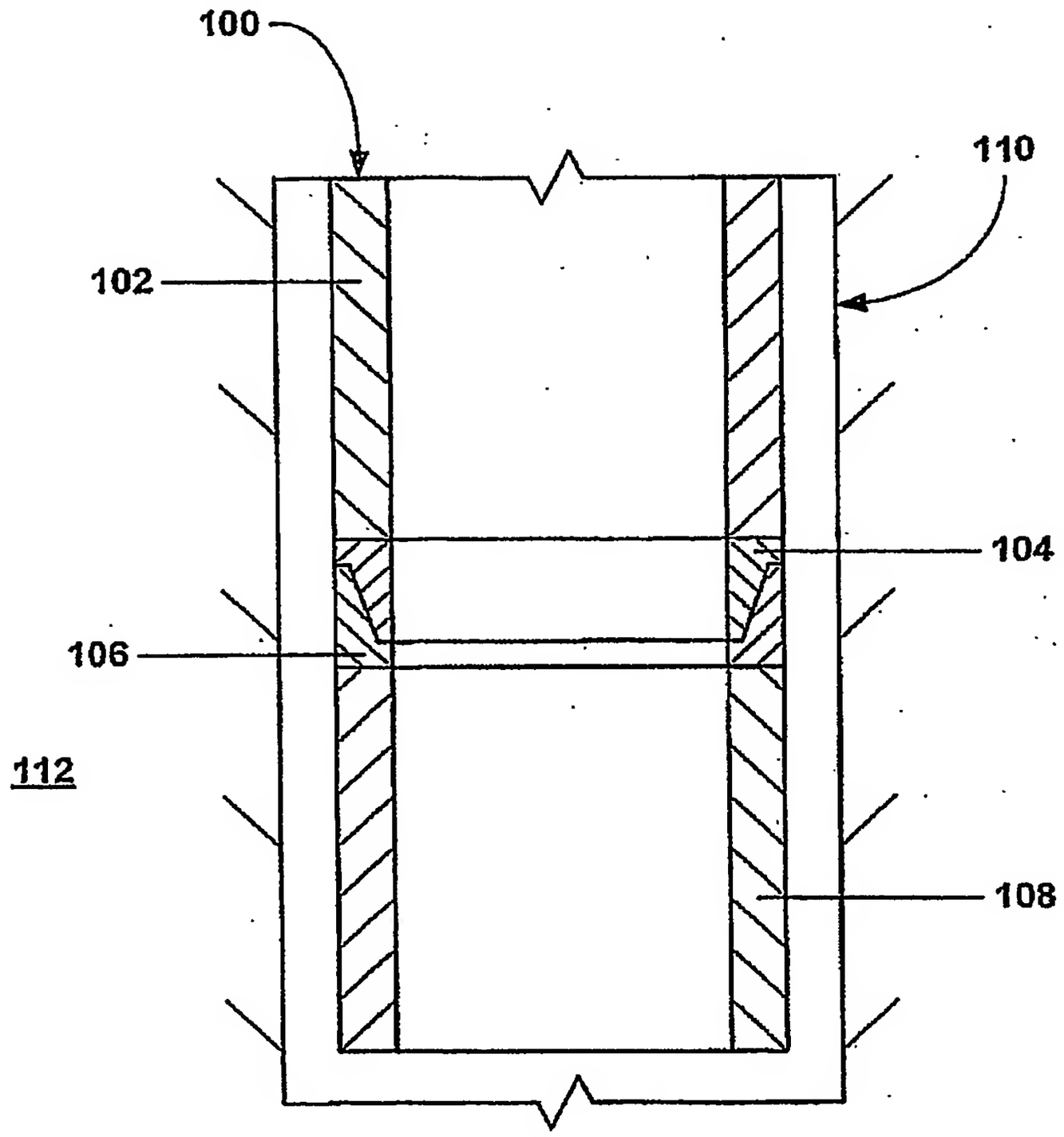


FIG. 8

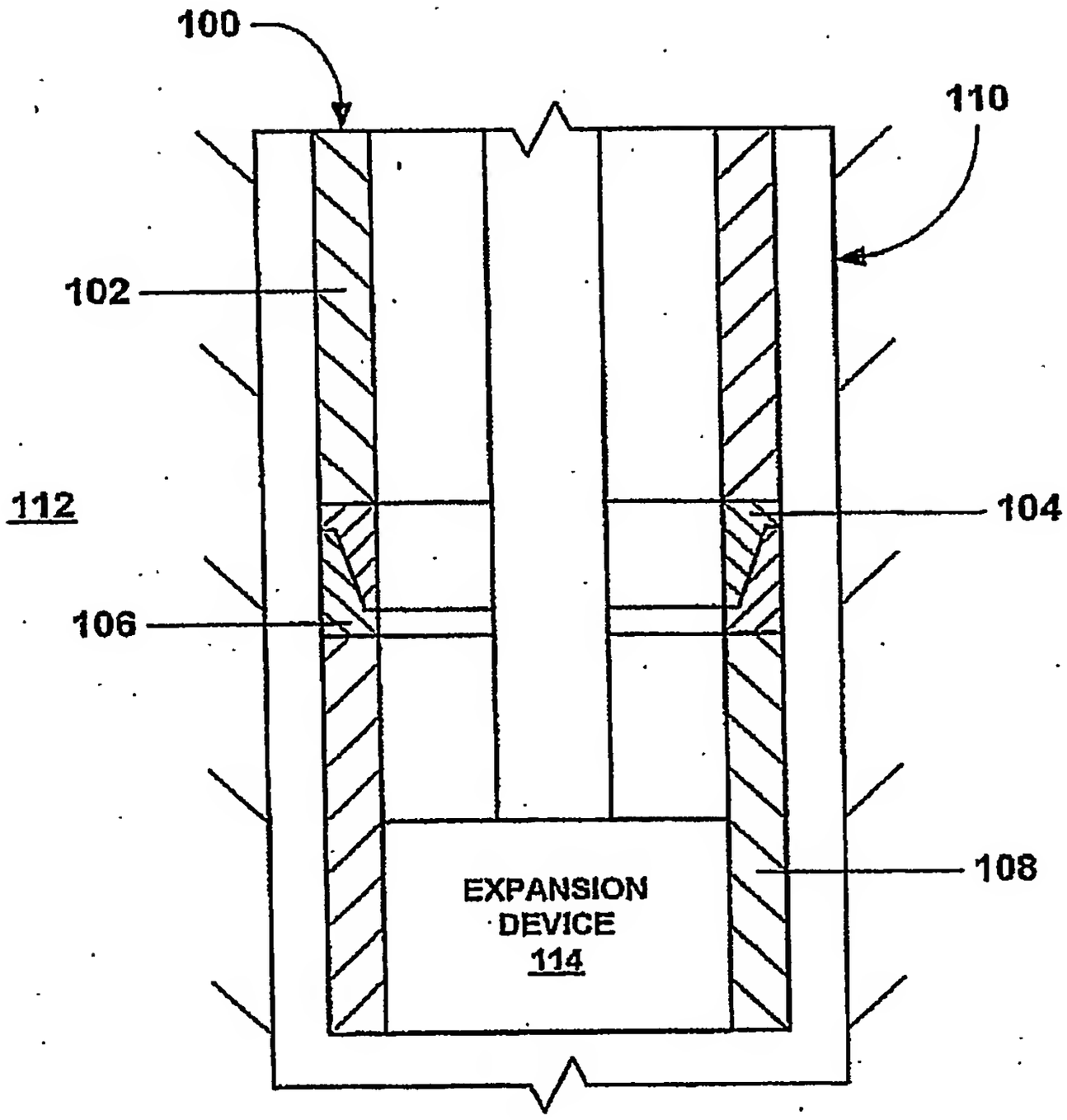


FIG. 9

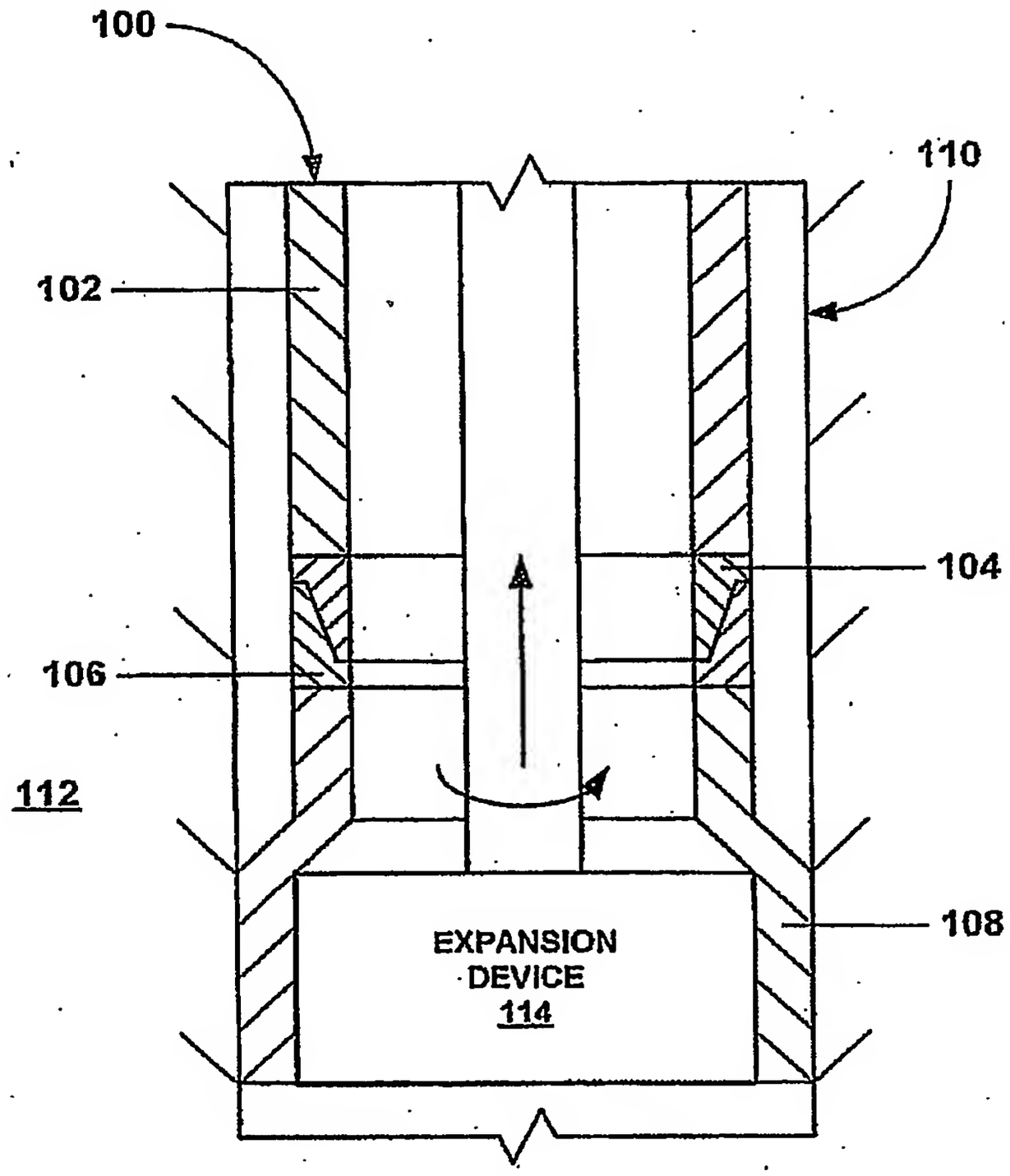


FIG. 10

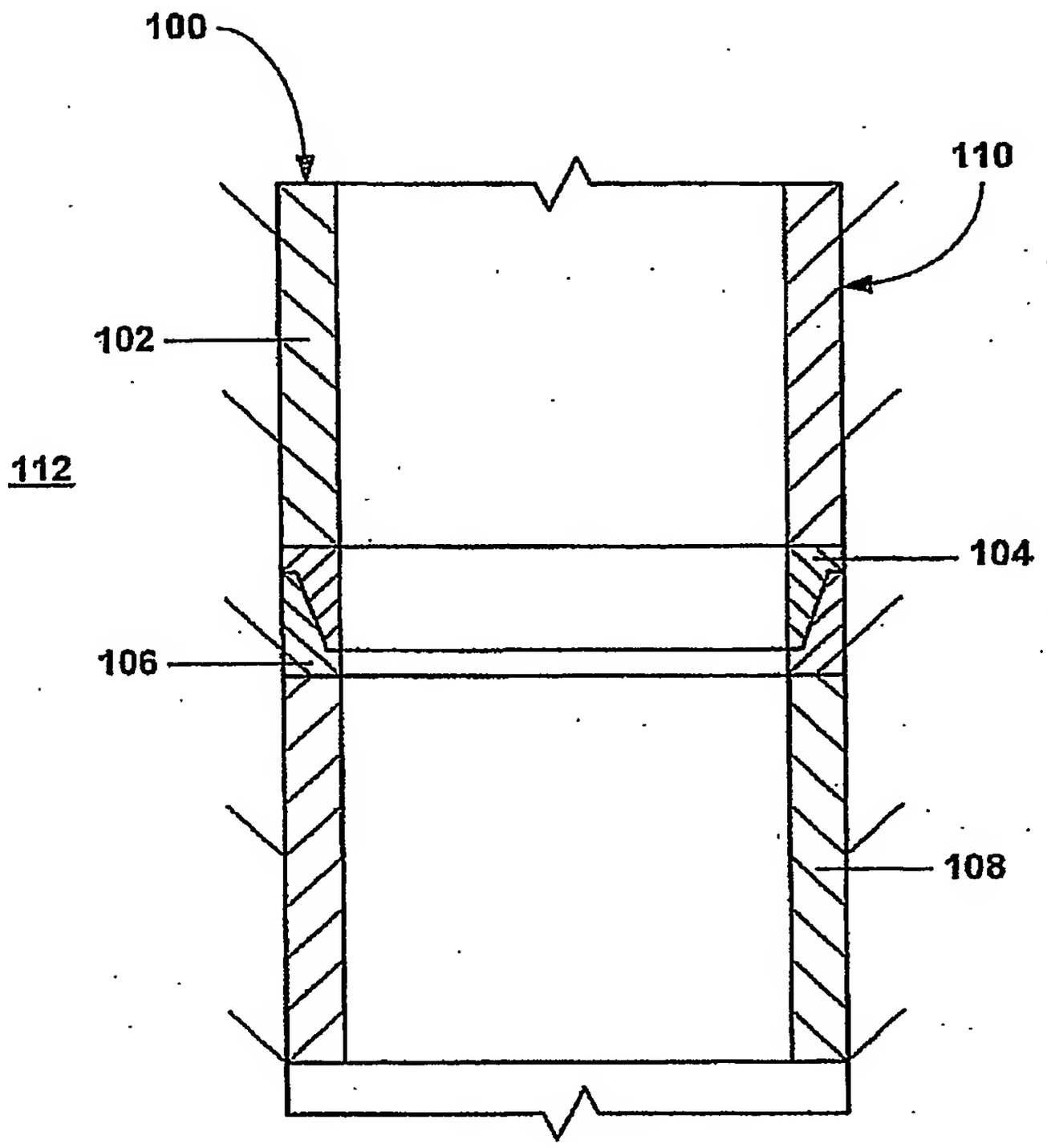


FIG. 11

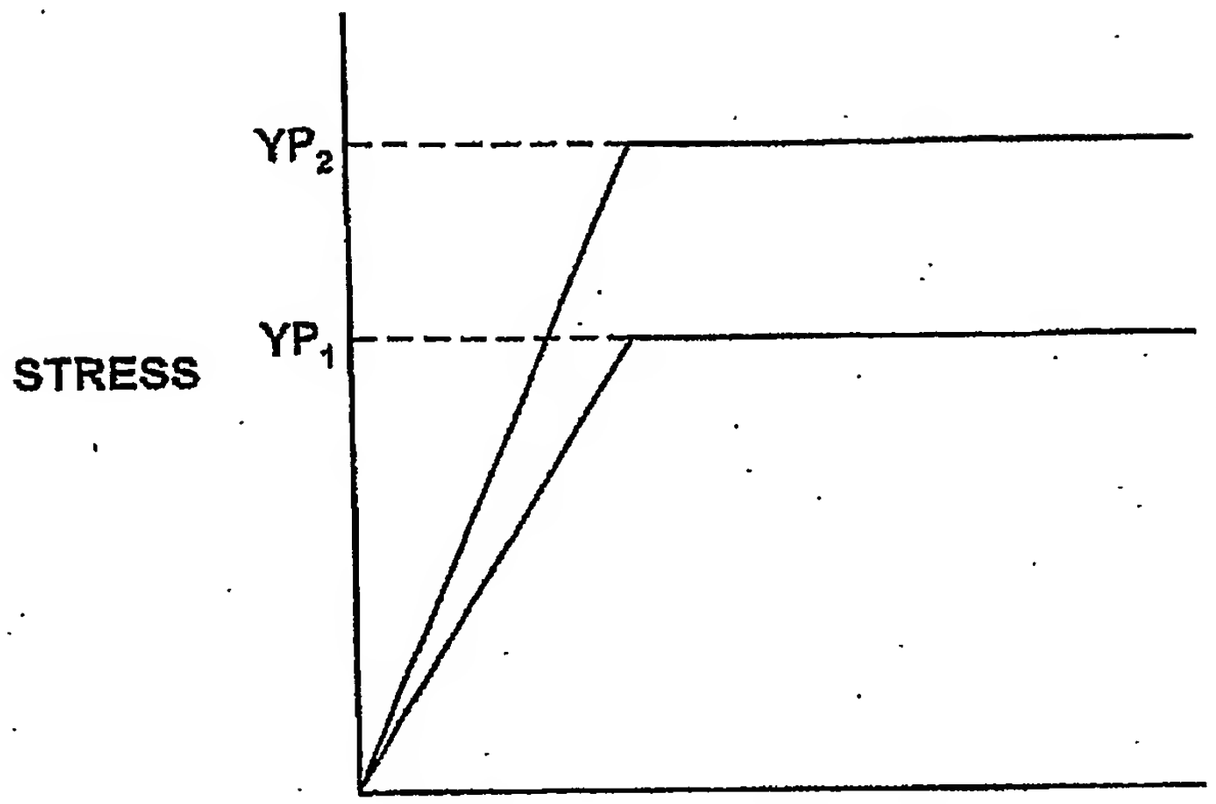

YP_2
YP_1
STRESS
STRAIN

FIG. 12

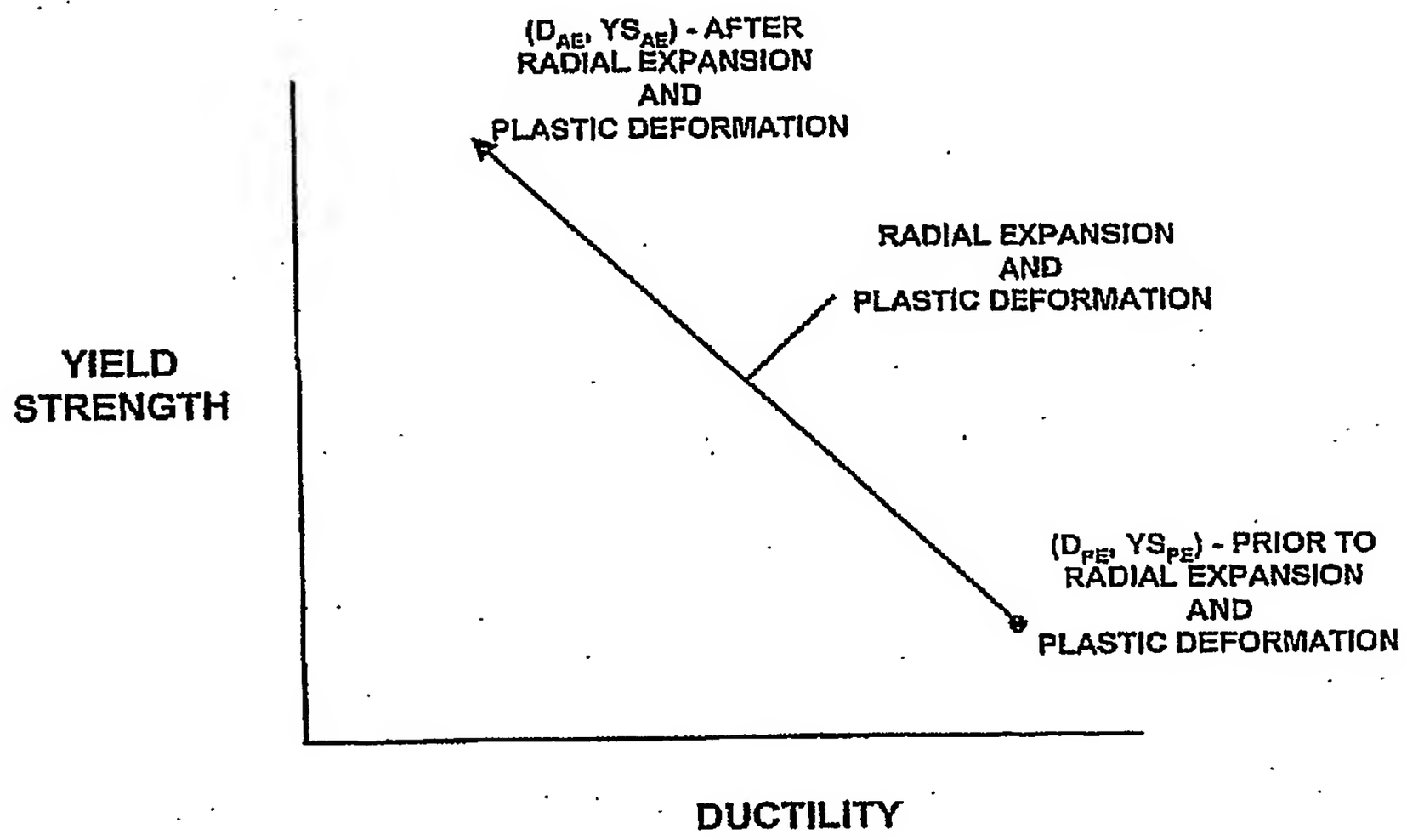

(D_{AE}, YS_{AE}) - AFTER RADIAL EXPANSION AND PLASTIC DEFORMATION
RADIAL EXPANSION AND PLASTIC DEFORMATION
(D_{PE}, YS_{PE}) - PRIOR TO RADIAL EXPANSION AND PLASTIC DEFORMATION
YIELD STRENGTH
DUCTILITY

FIG. 13

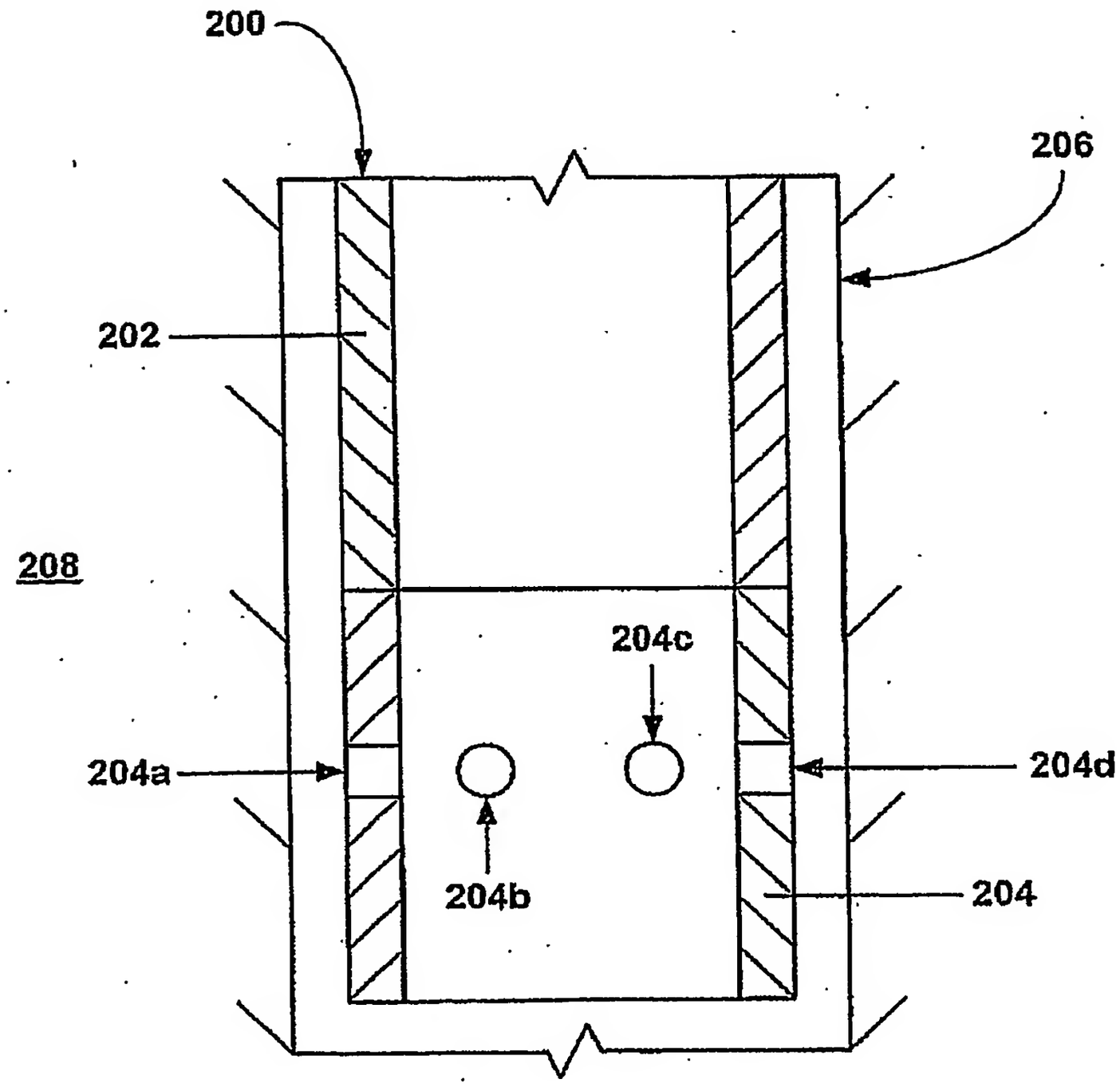


FIG. 14

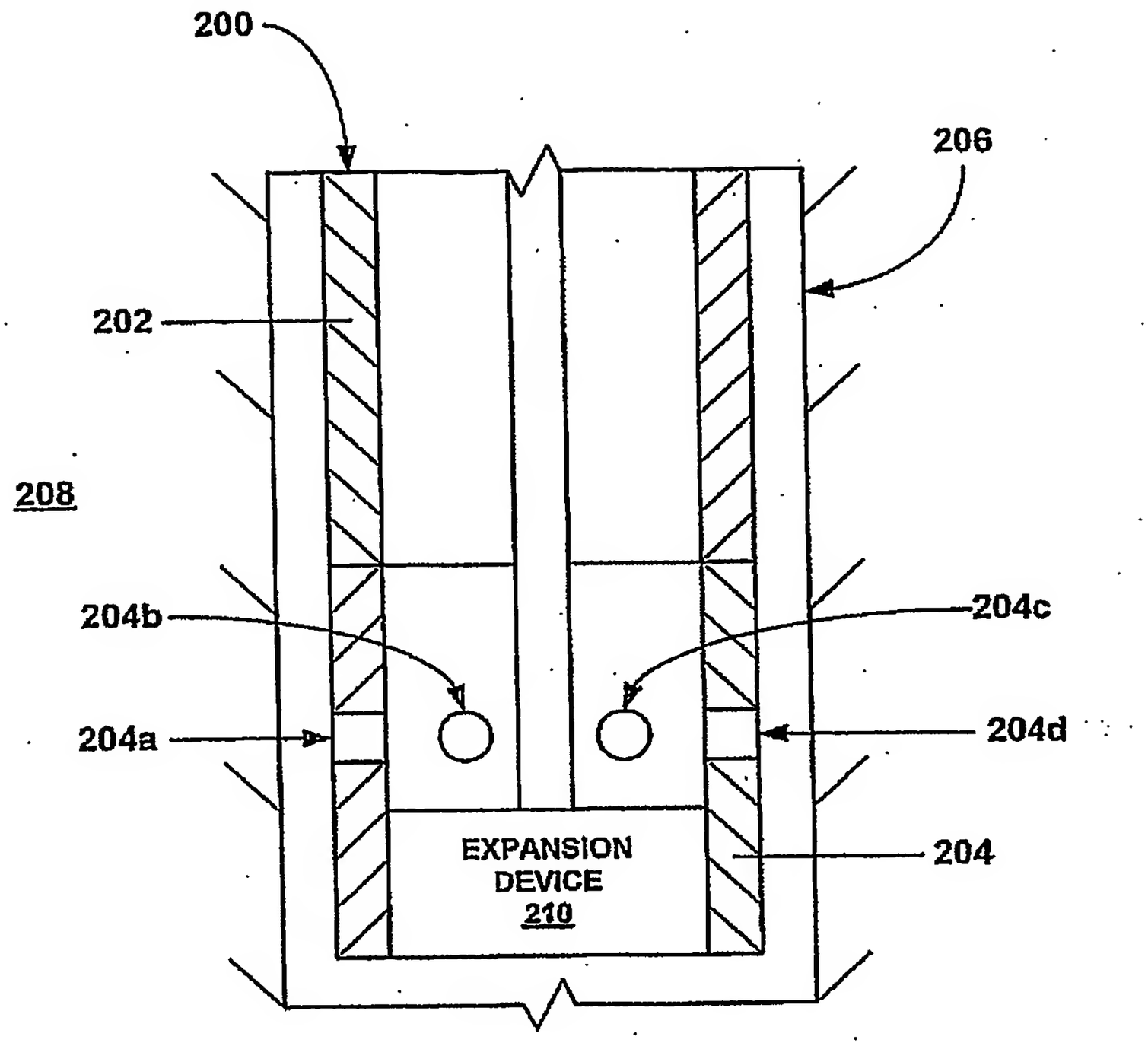


FIG. 15

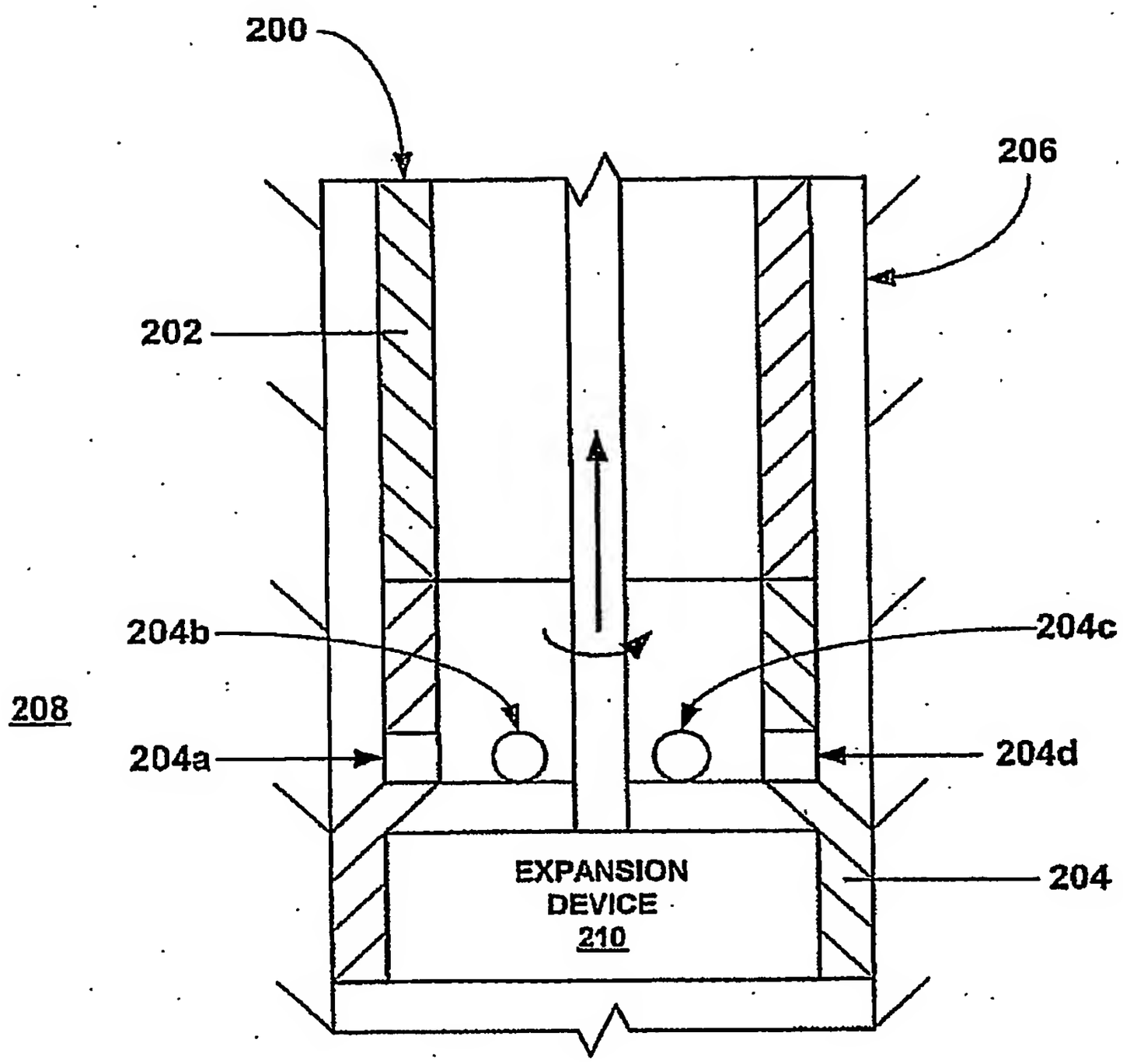


FIG. 16

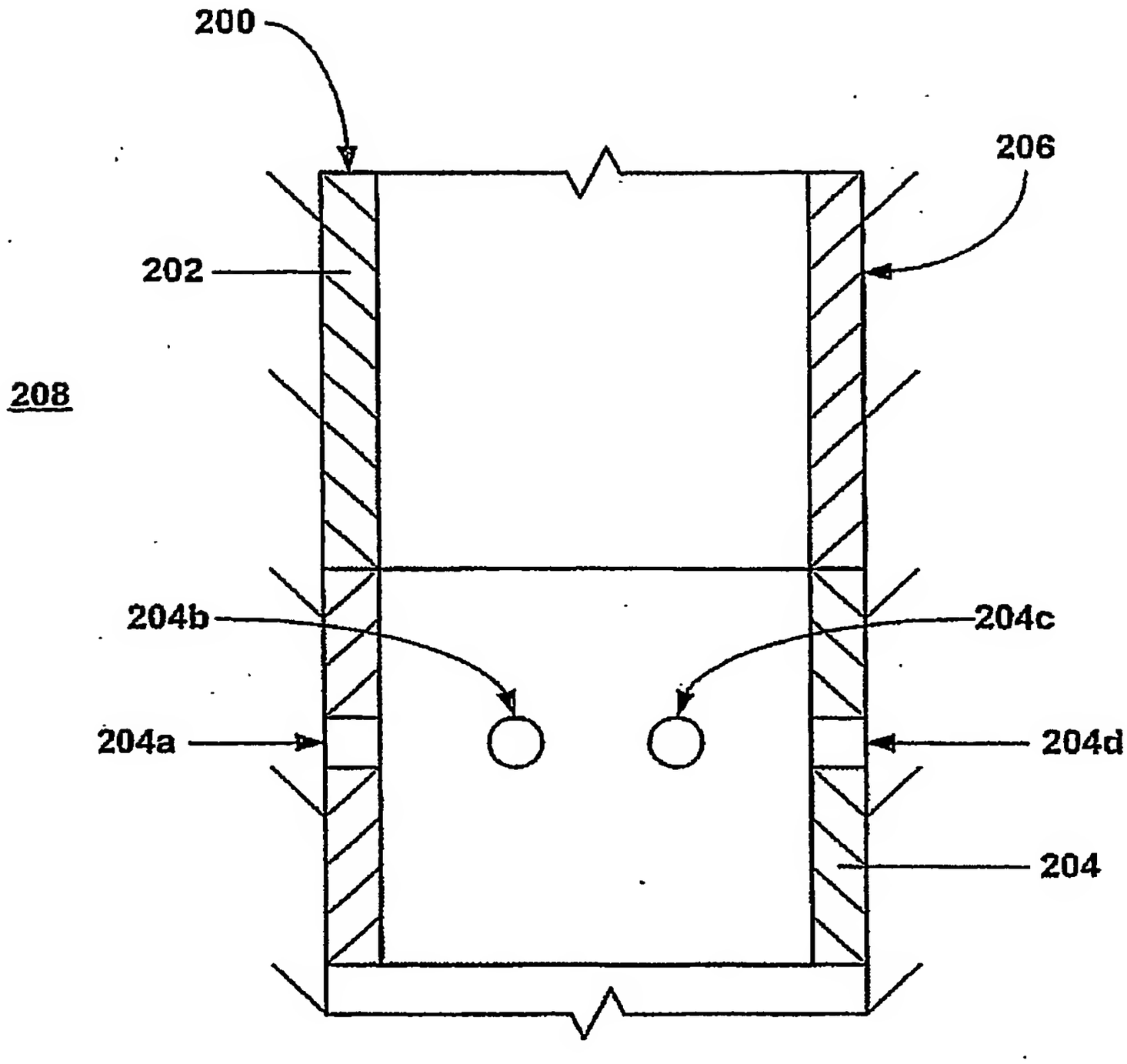


FIG. 17

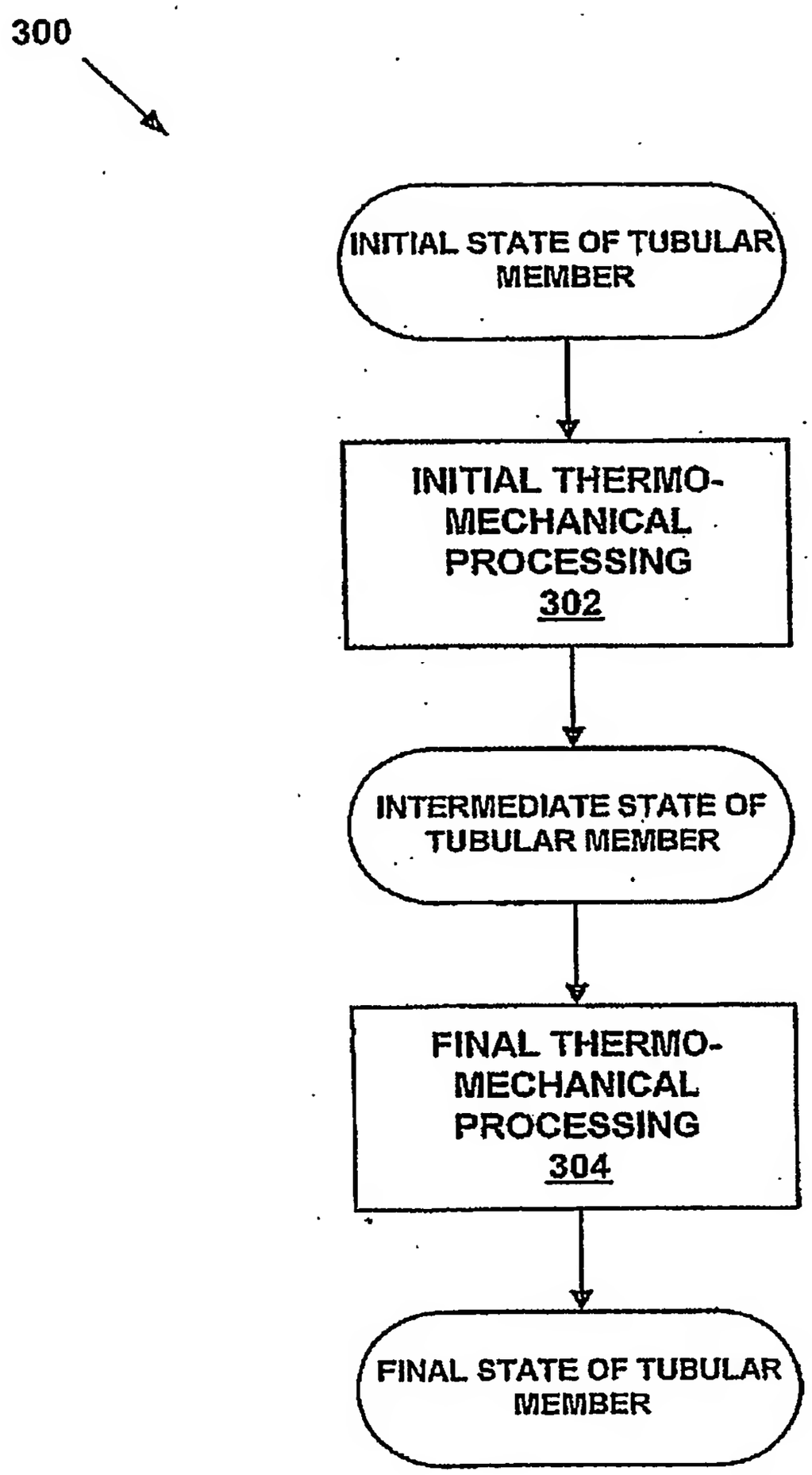

300
INITIAL STATE OF TUBULAR MEMBER
INITIAL THERMO-MECHANICAL PROCESSING
302
INTERMEDIATE STATE OF TUBULAR MEMBER
FINAL THERMO-MECHANICAL PROCESSING
304
FINAL STATE OF TUBULAR MEMBER

Fig. 18

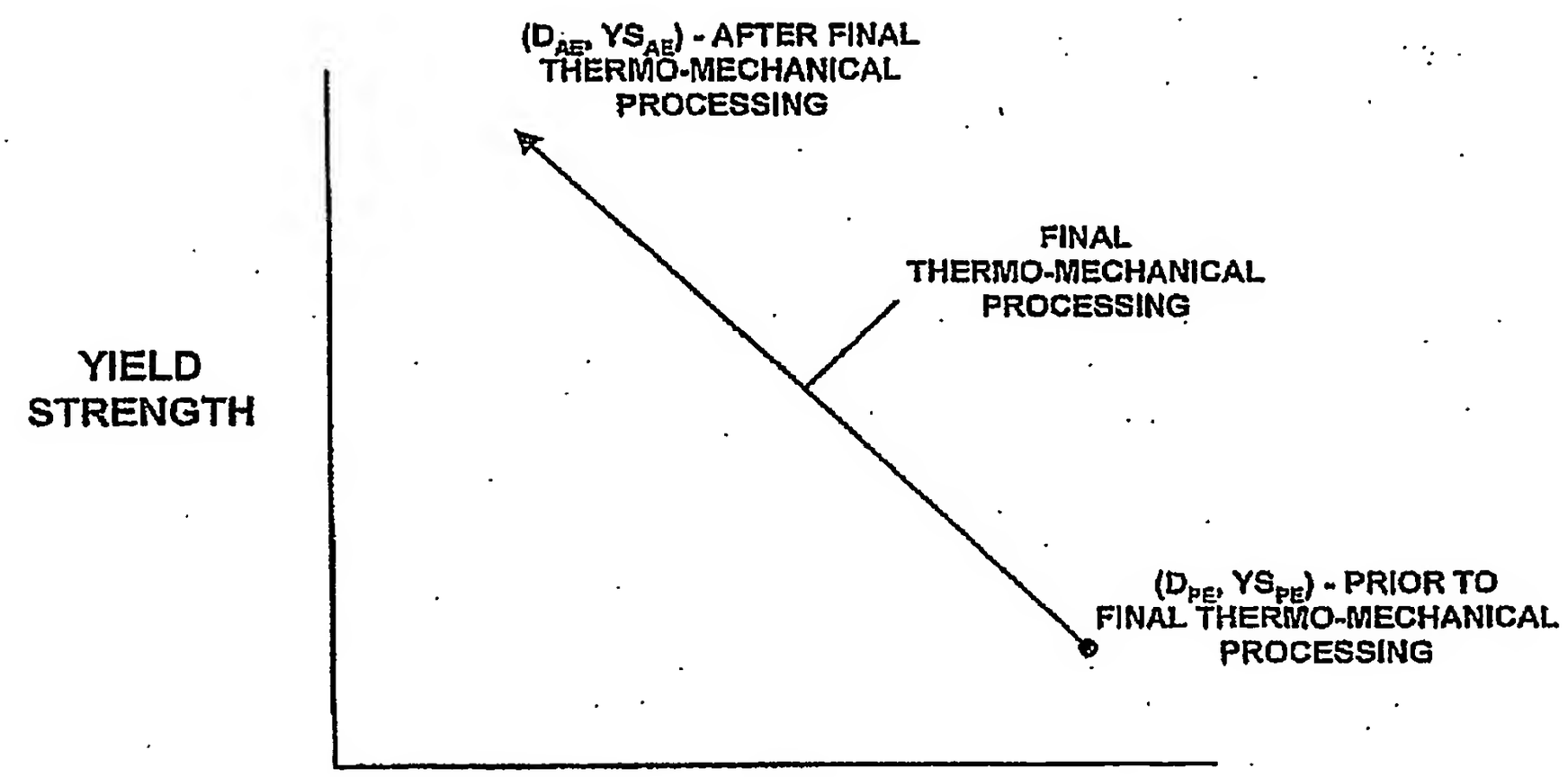

(D_{AE}, YS_{AE}) - AFTER FINAL THERMO-MECHANICAL PROCESSING
FINAL THERMO-MECHANICAL PROCESSING
(D_{PE}, YS_{PE}) - PRIOR TO FINAL THERMO-MECHANICAL PROCESSING
YIELD STRENGTH
DUCTILITY

FIG. 19

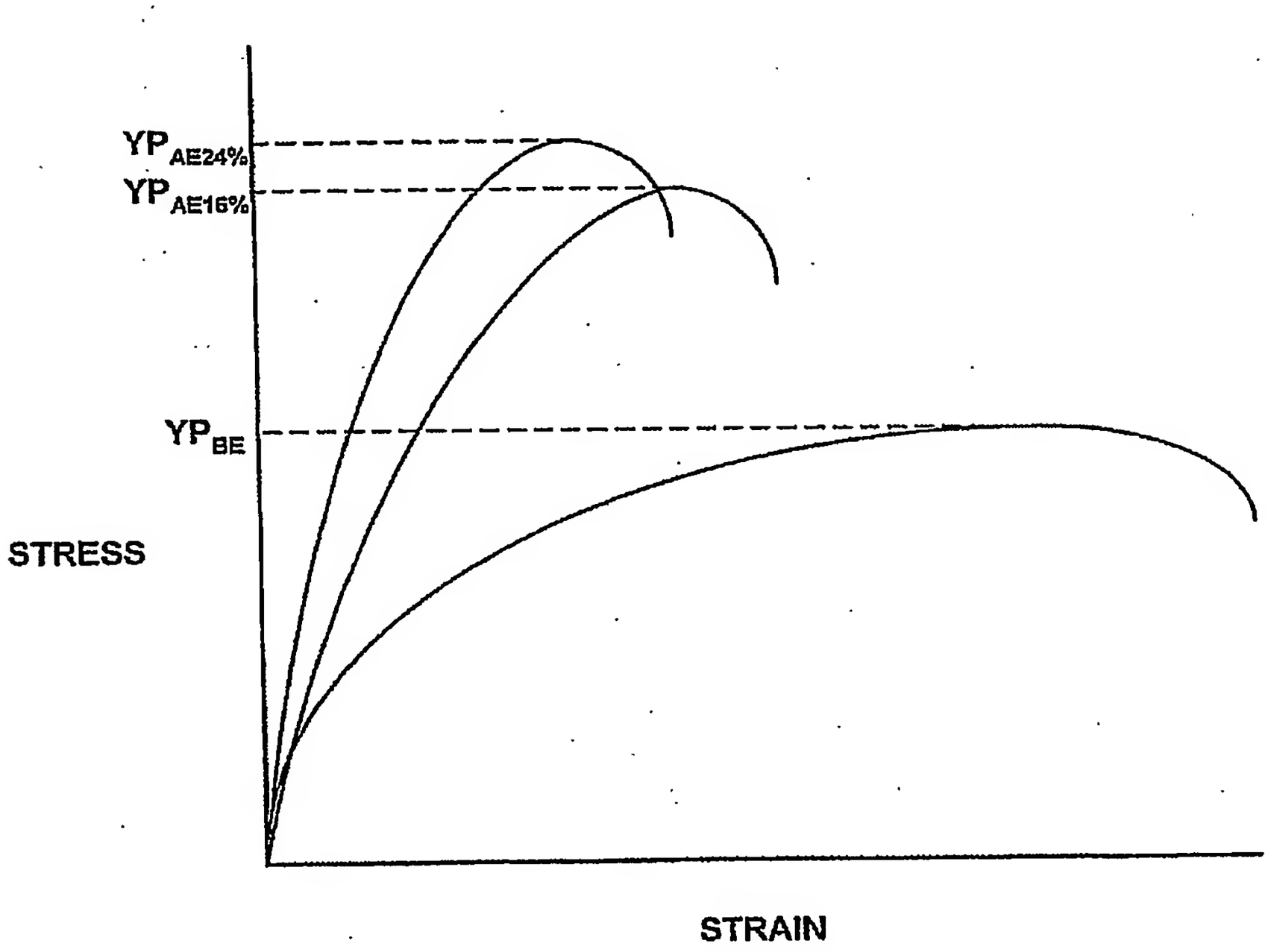


FIG. 20

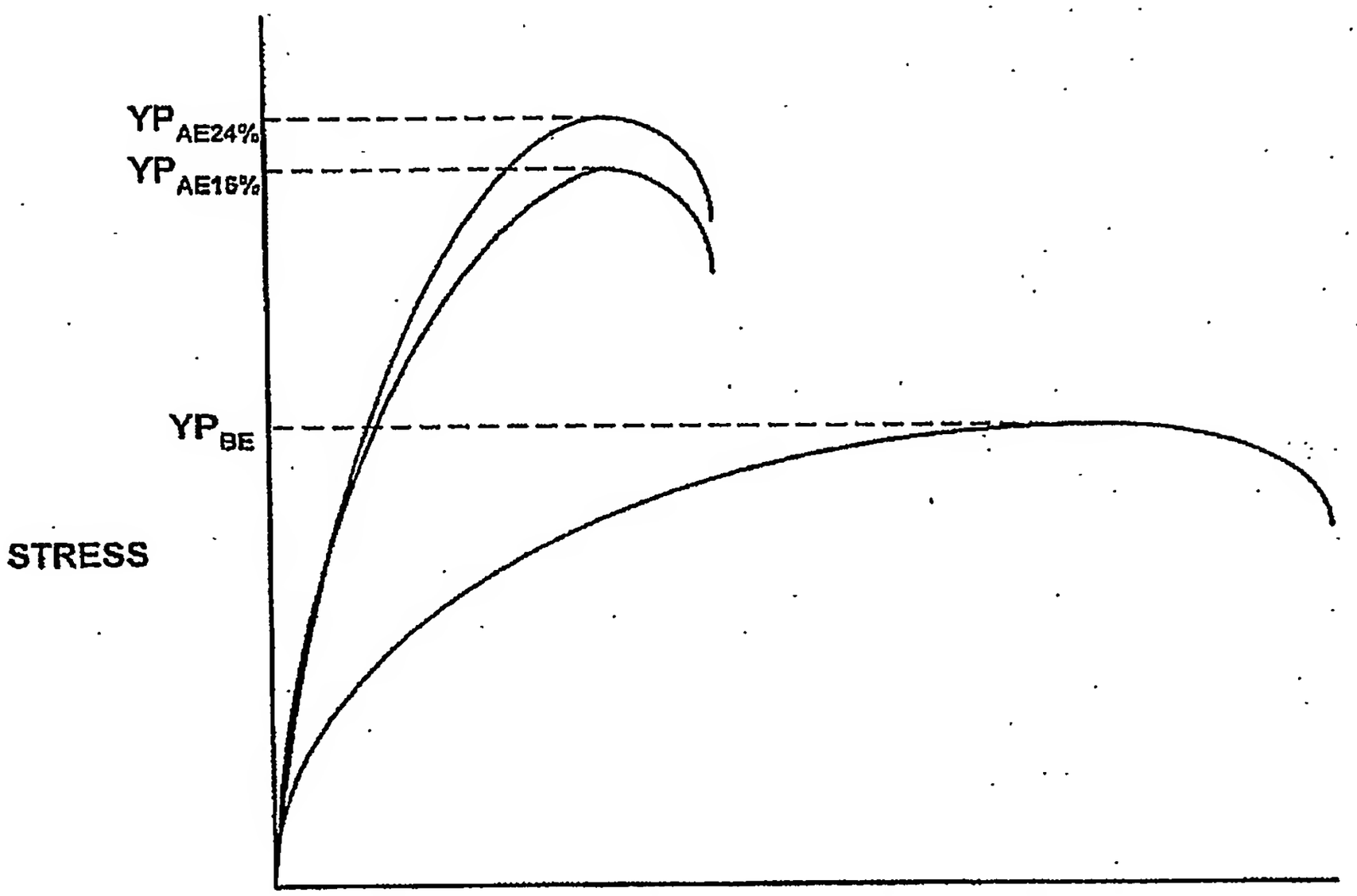


FIG. 21

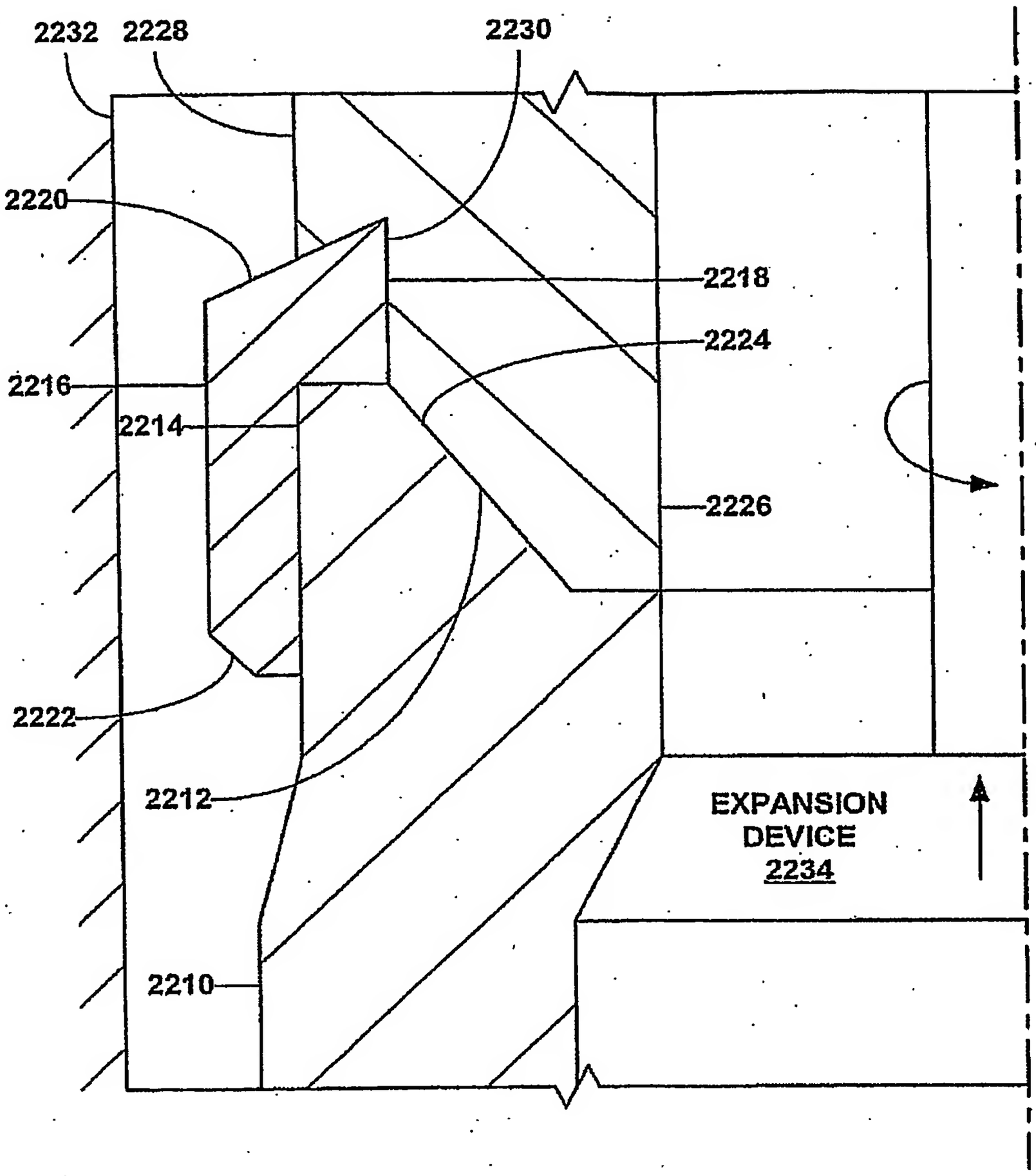

2232
2228
2230
2220
2218
2224
2216
2214
2226
2222
2212
EXPANSION
DEVICE
2234
2210

FIG. 22

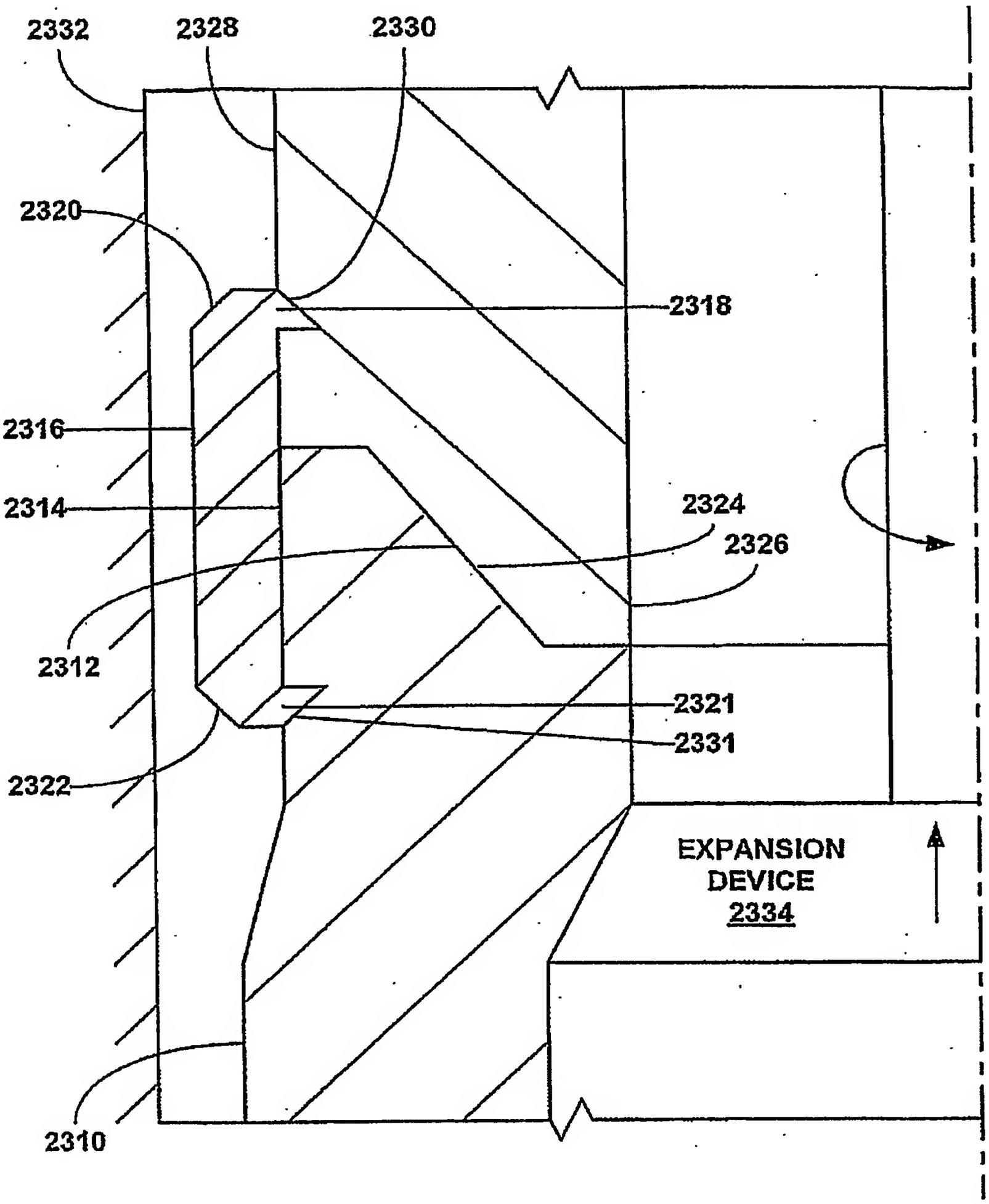

2332
2328
2330
2320
2318
2316
2314
2324
2326
2312
2321
2331
2322
EXPANSION DEVICE 2334
2310

FIG. 23

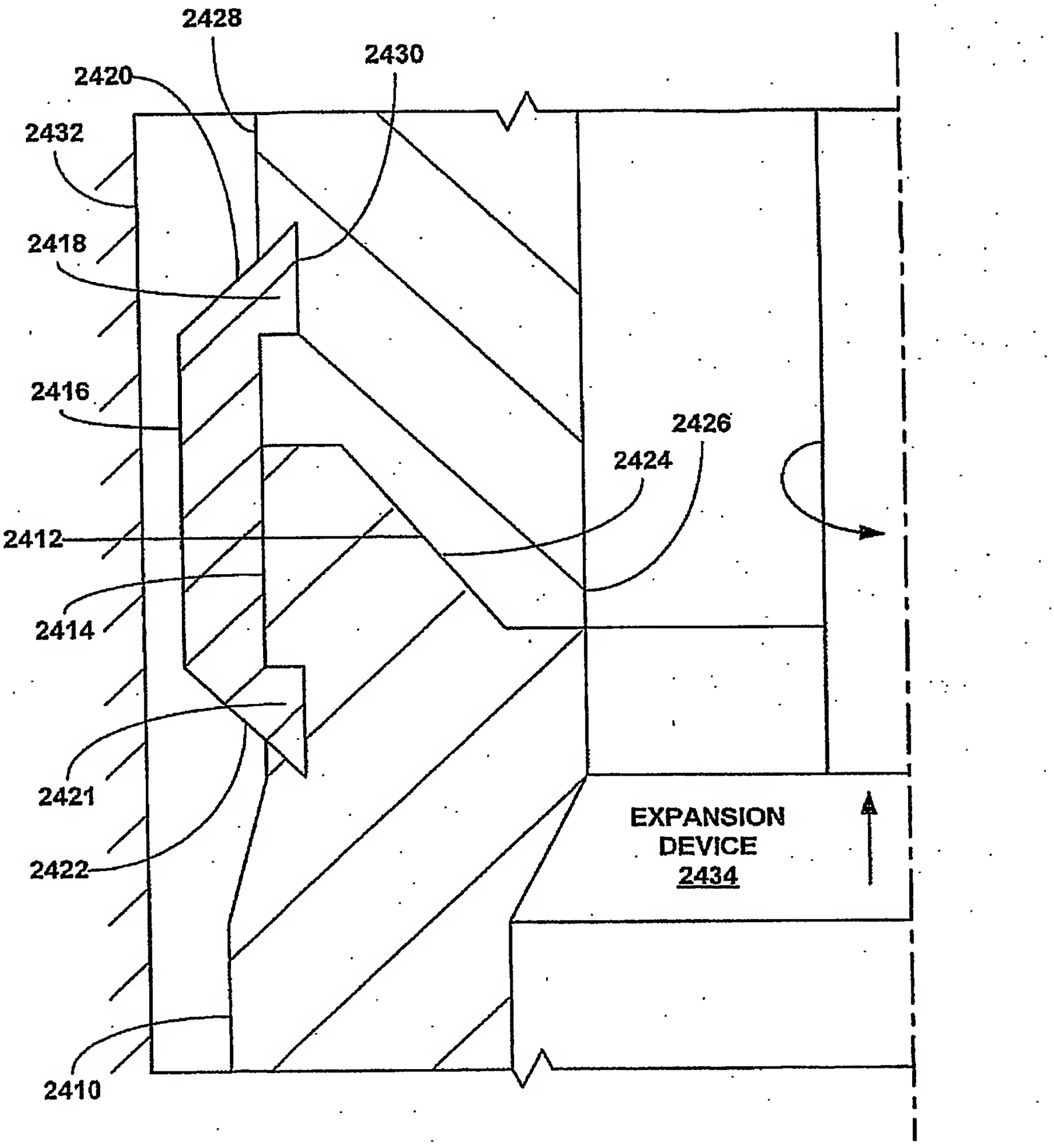

2428
2430
2420
2432
2418
2416
2426
2424
2412
2414
2421
2422
EXPANSION
DEVICE
2434
2410

FIG. 24

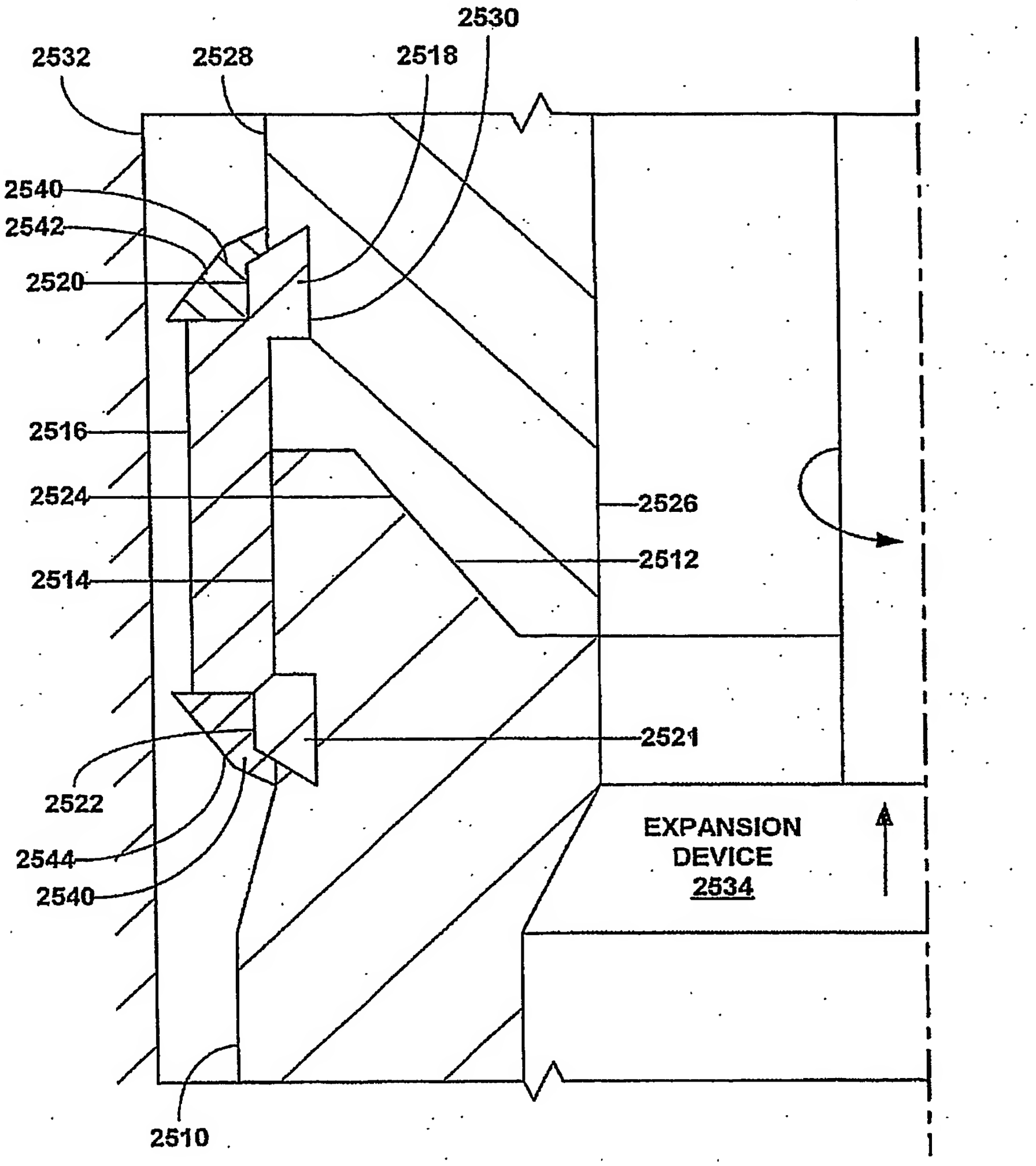

2530
2532
2528
2518
2540
2542
2520
2516
2524
2526
2514
2512
2521
2522
2544
2540
EXPANSION
DEVICE
2534
2510

FIG. 25

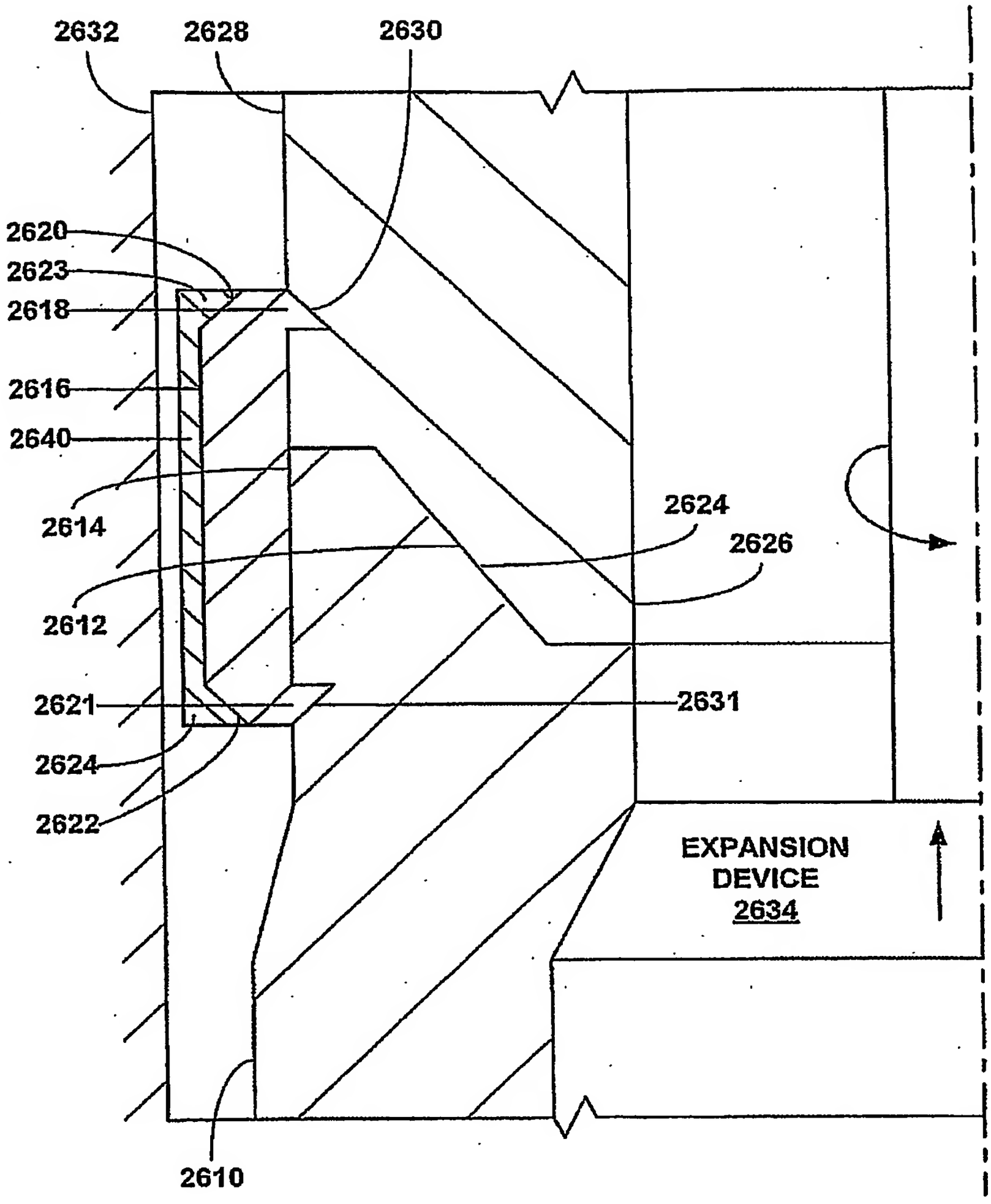

2632
2628
2630
2620
2623
2618
2616
2640
2614
2612
2621
2624
2622
2610
2624
2626
2631
EXPANSION
DEVICE
2634

FIG. 26

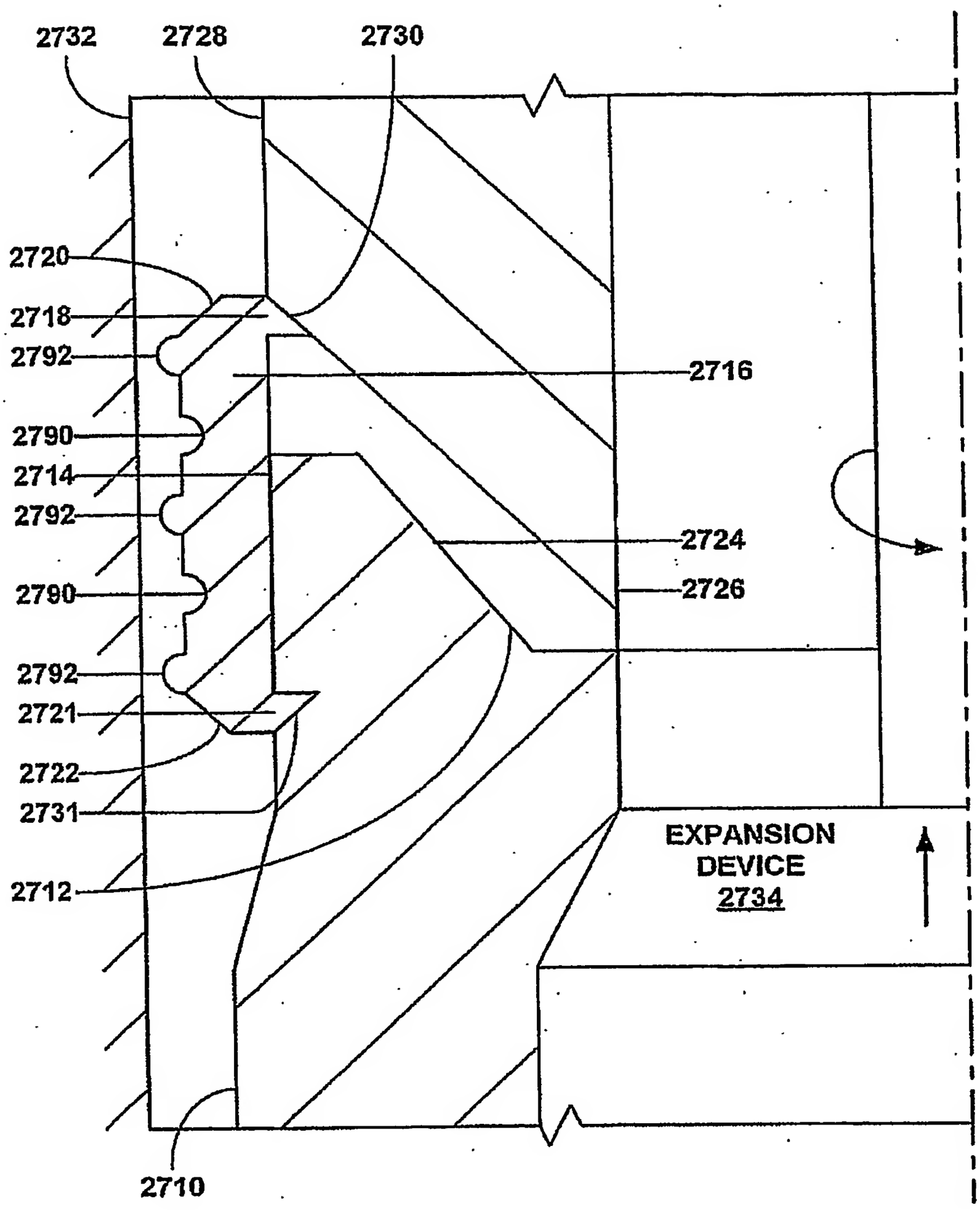
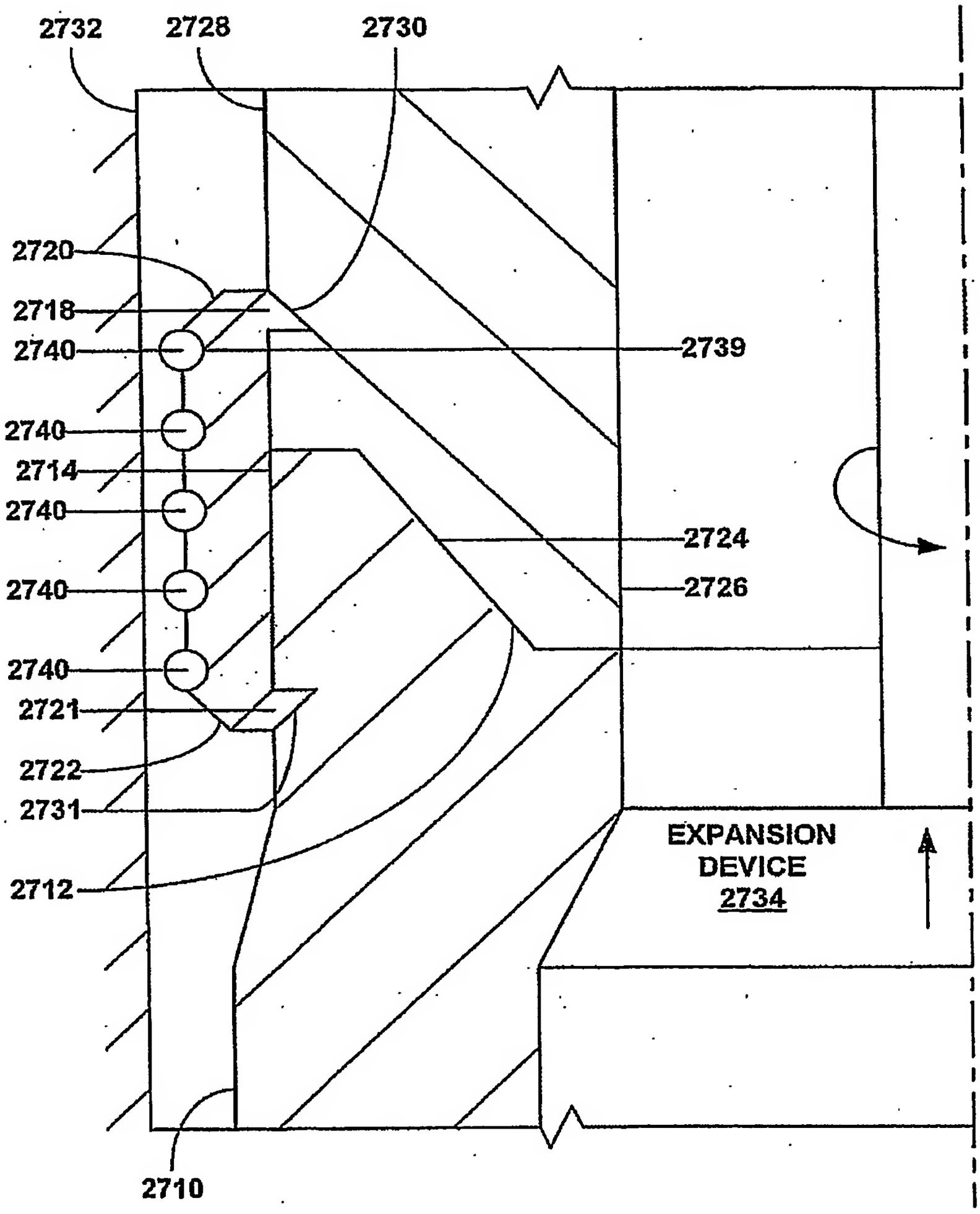

2732
2728
2730
2720
2718
2792
2716
2790
2714
2792
2724
2790
2726
2792
2721
2722
2731
2712
EXPANSION DEVICE 2734
2710

FIG. 27


2732
2728
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2720
2718
2740
2739
2740
2714
2740
2724
2740
2726
2740
2721
2722
2731
2712
EXPANSION DEVICE 2734
2710

FIG. 28

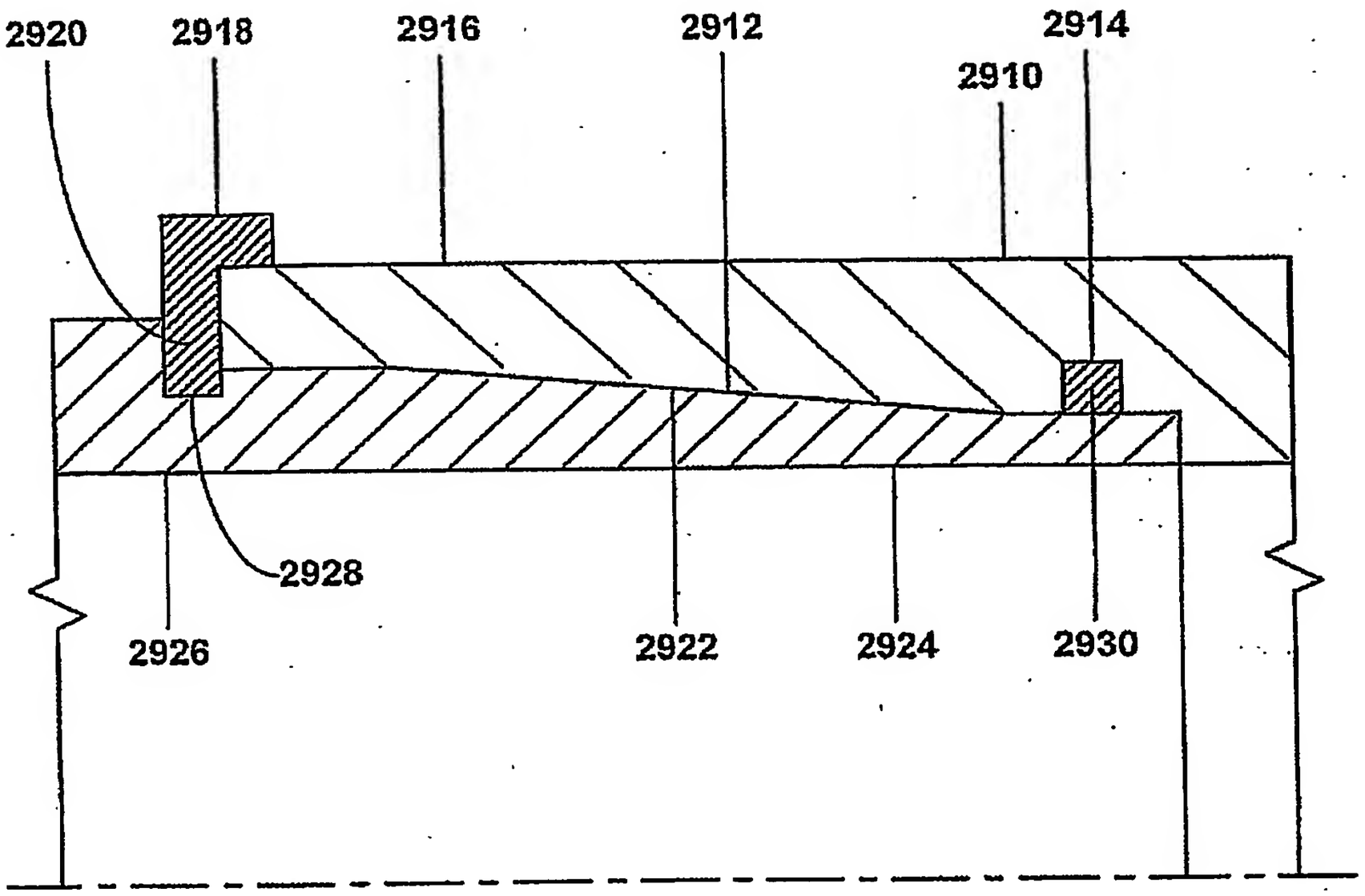


FIG. 29

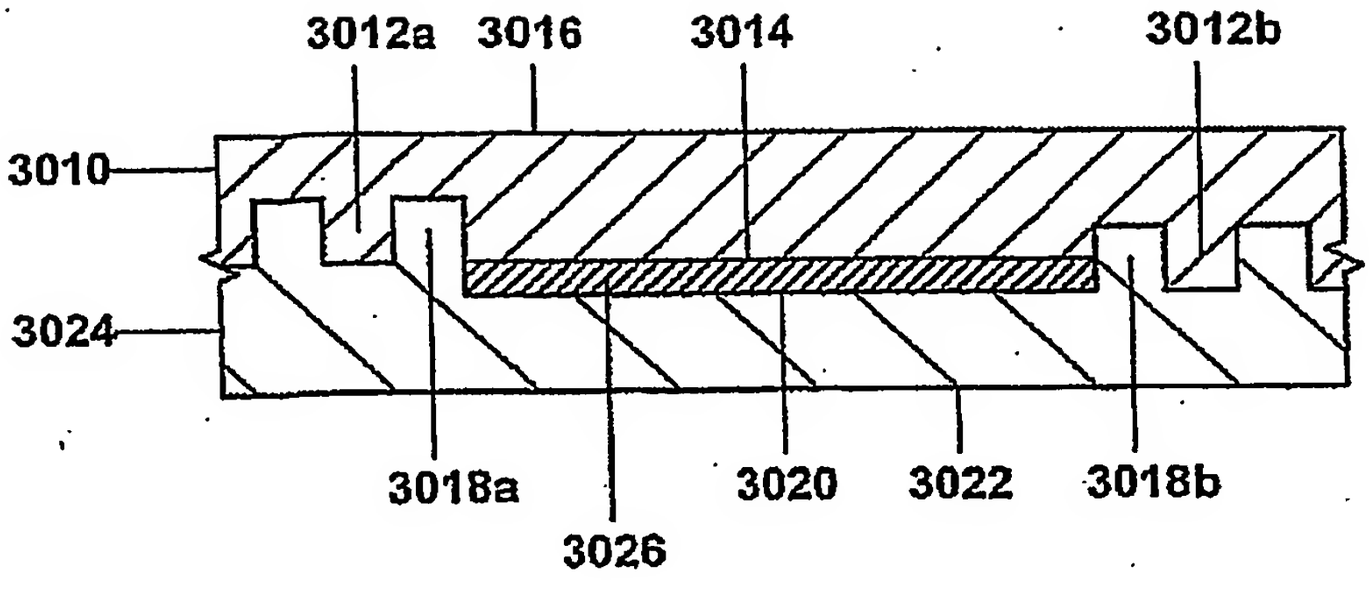


FIG. 30a

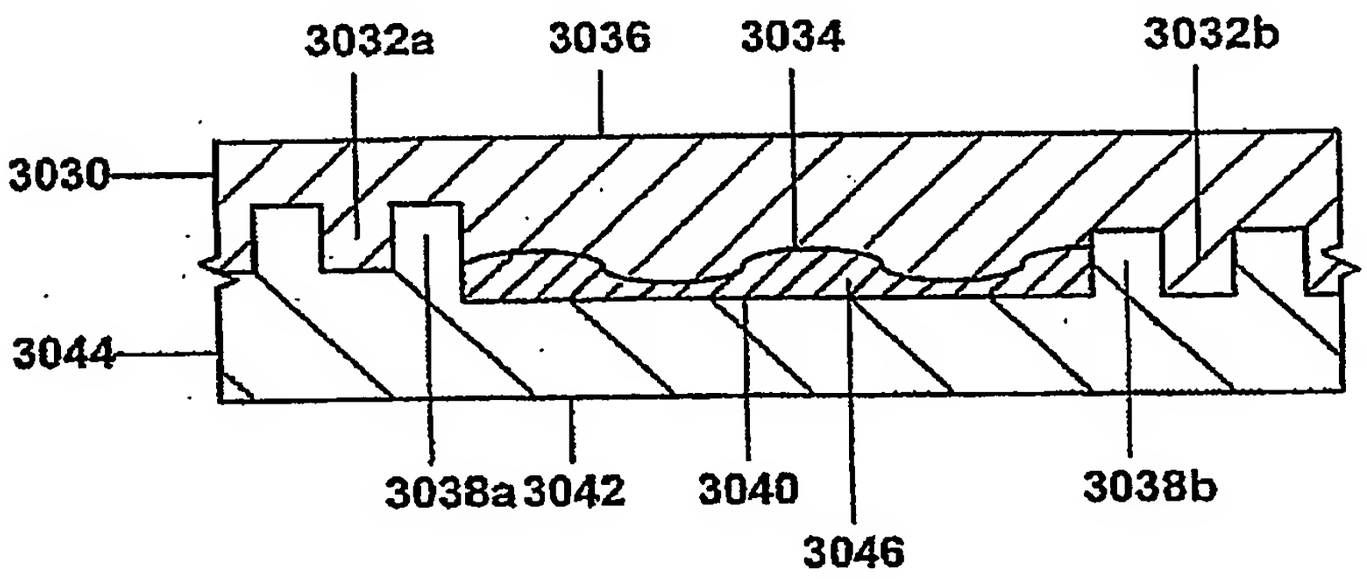


FIG. 30b

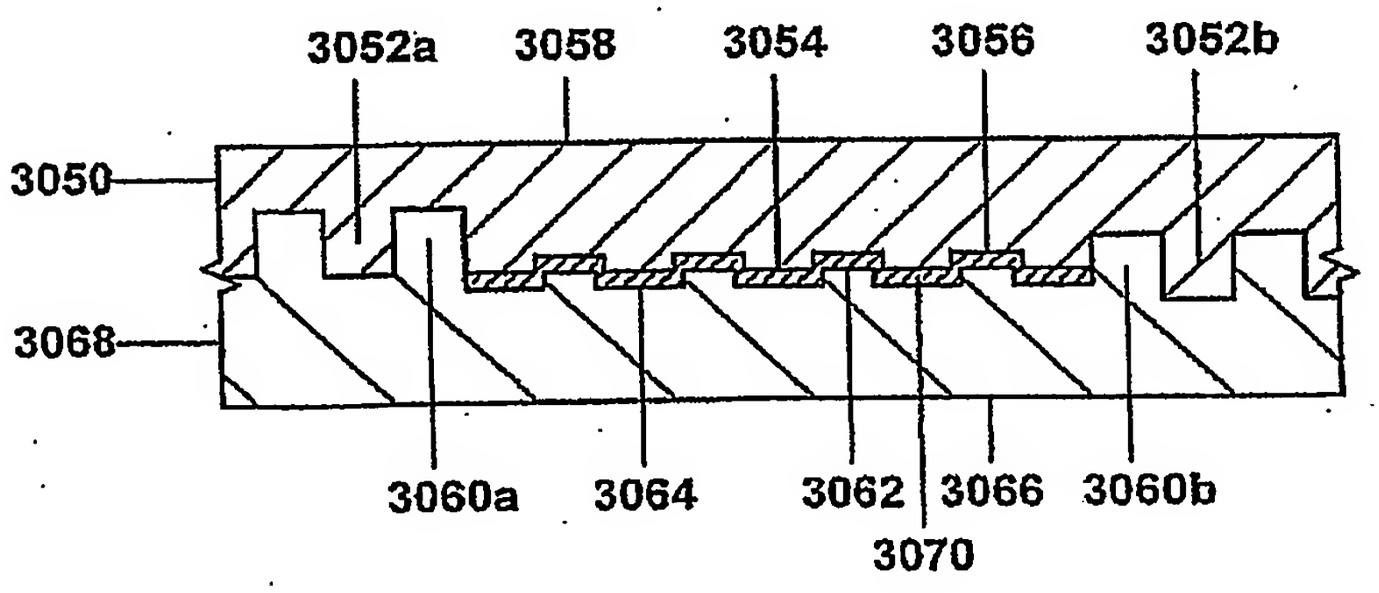


FIG. 30c

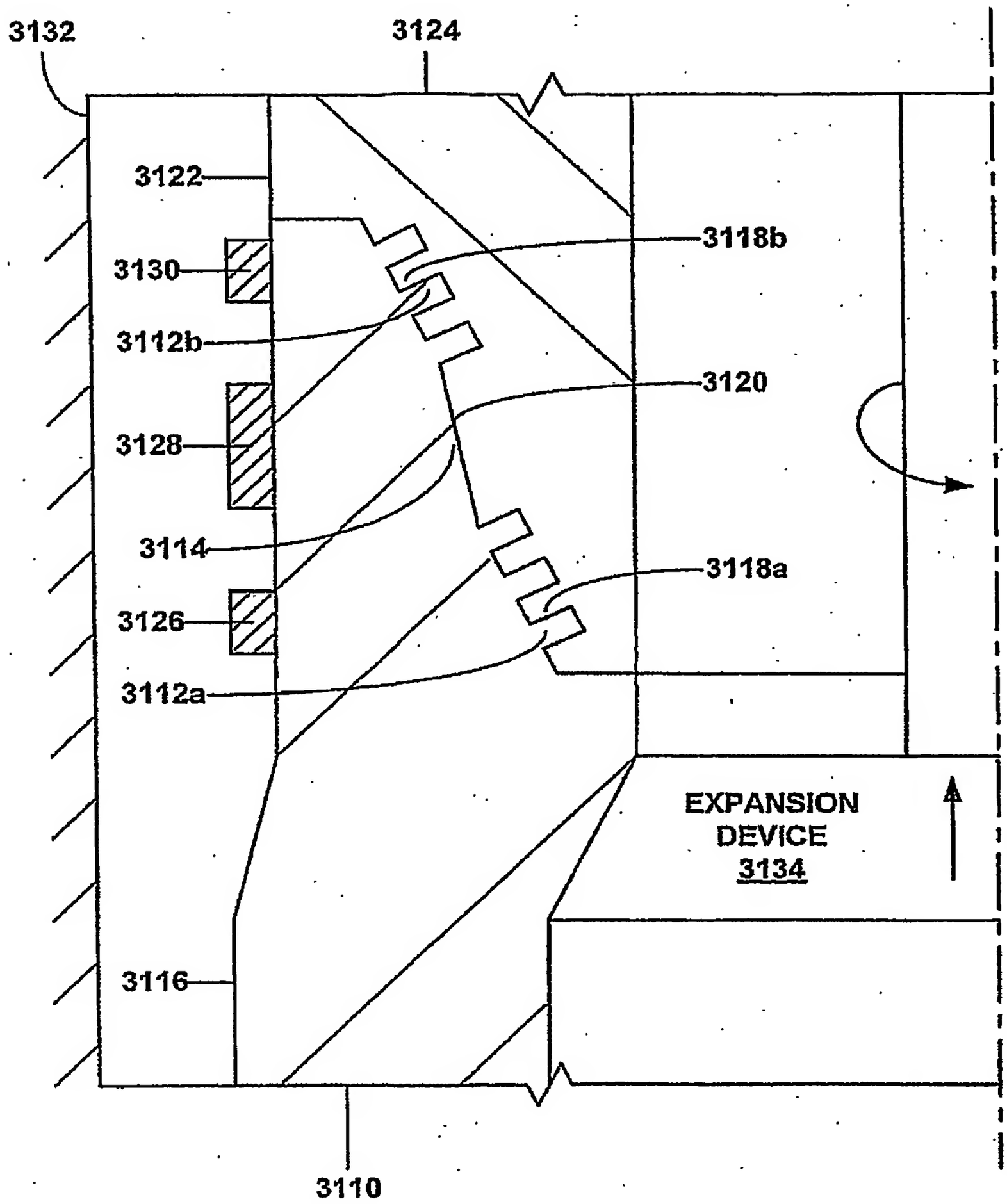

3132
3124
3122
3118b
3130
3112b
3120
3128
3114
3118a
3126
3112a
EXPANSION DEVICE 3134
3116
3110

FIG. 31

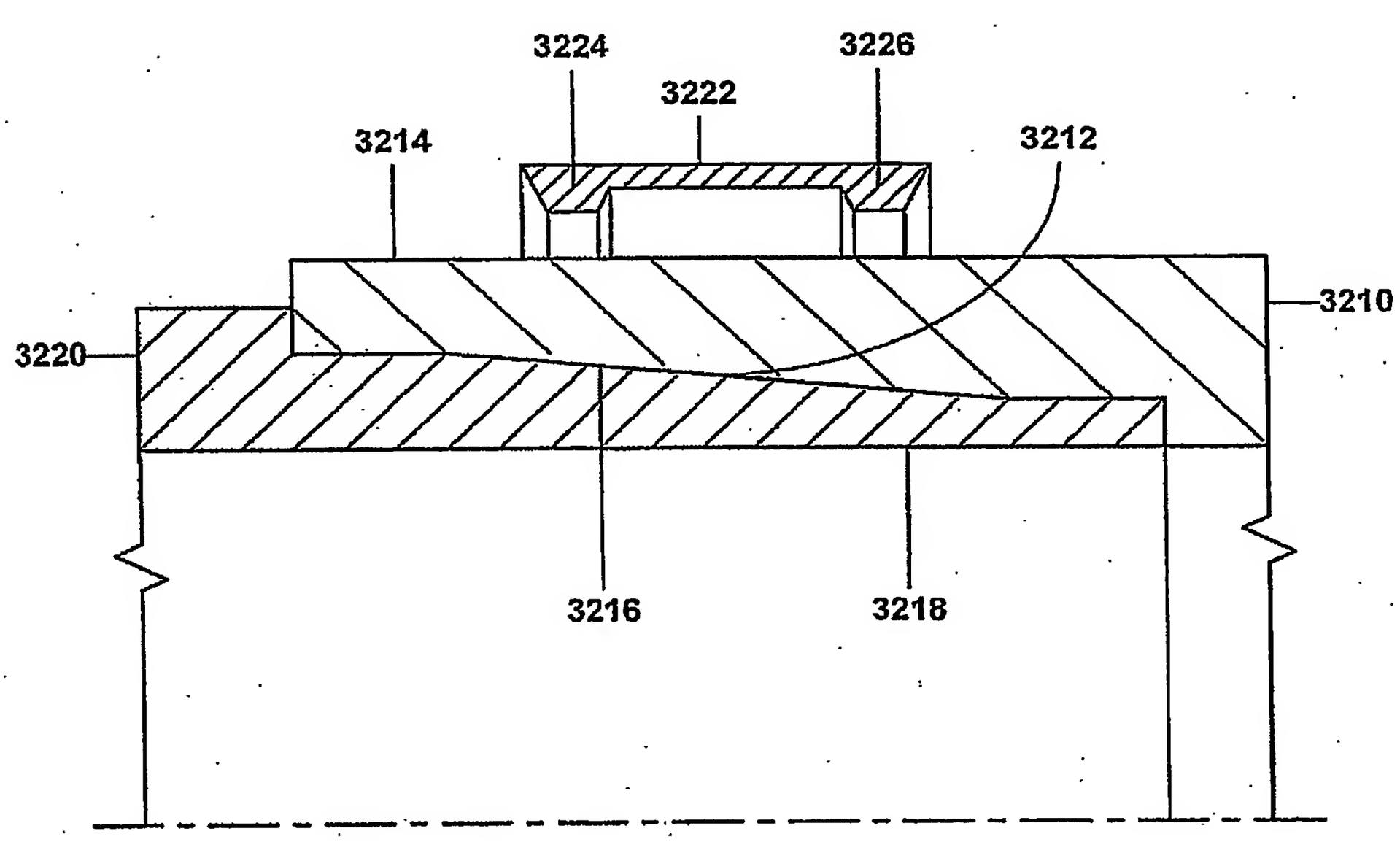


FIG. 32a

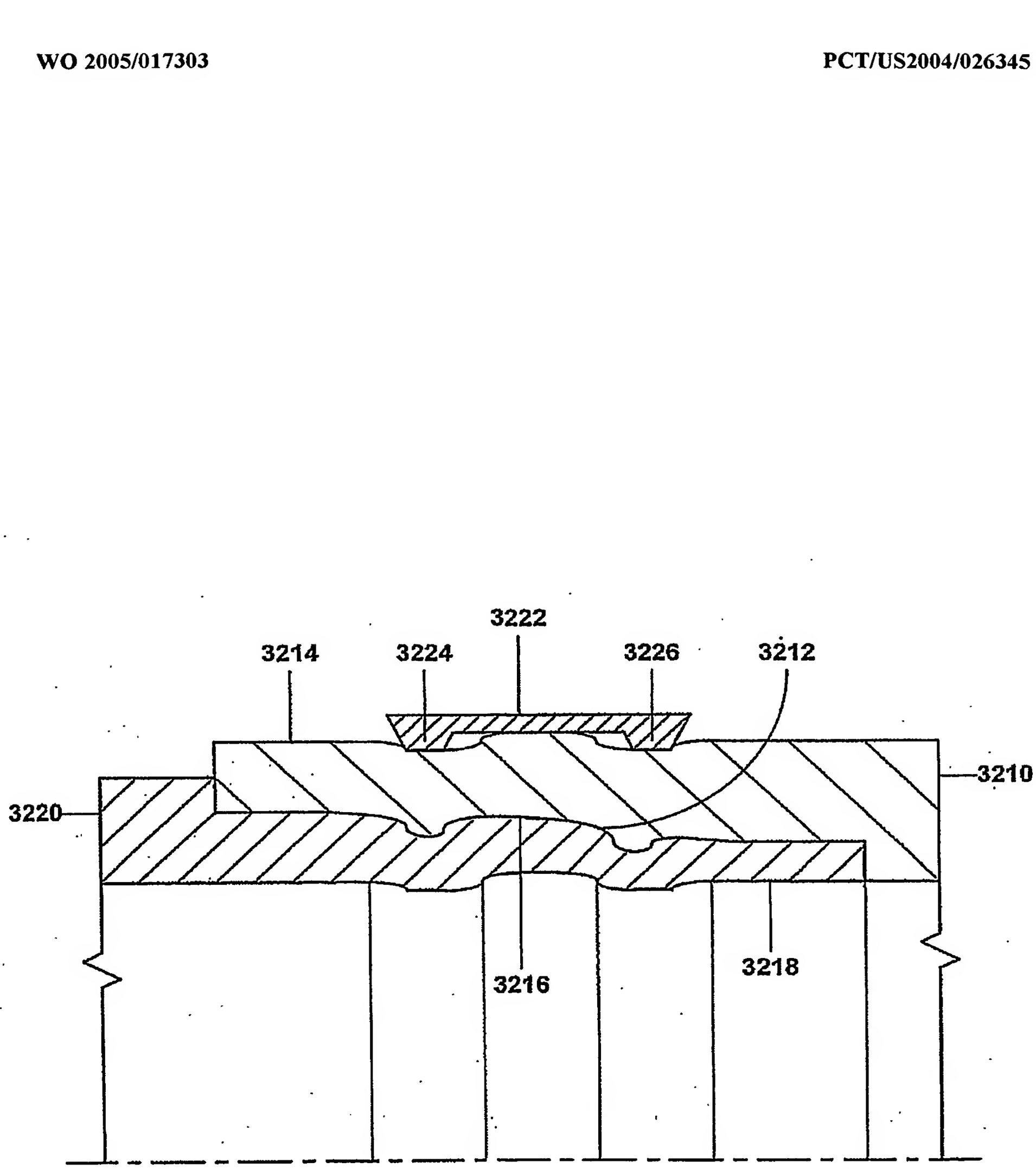


FIG. 32b

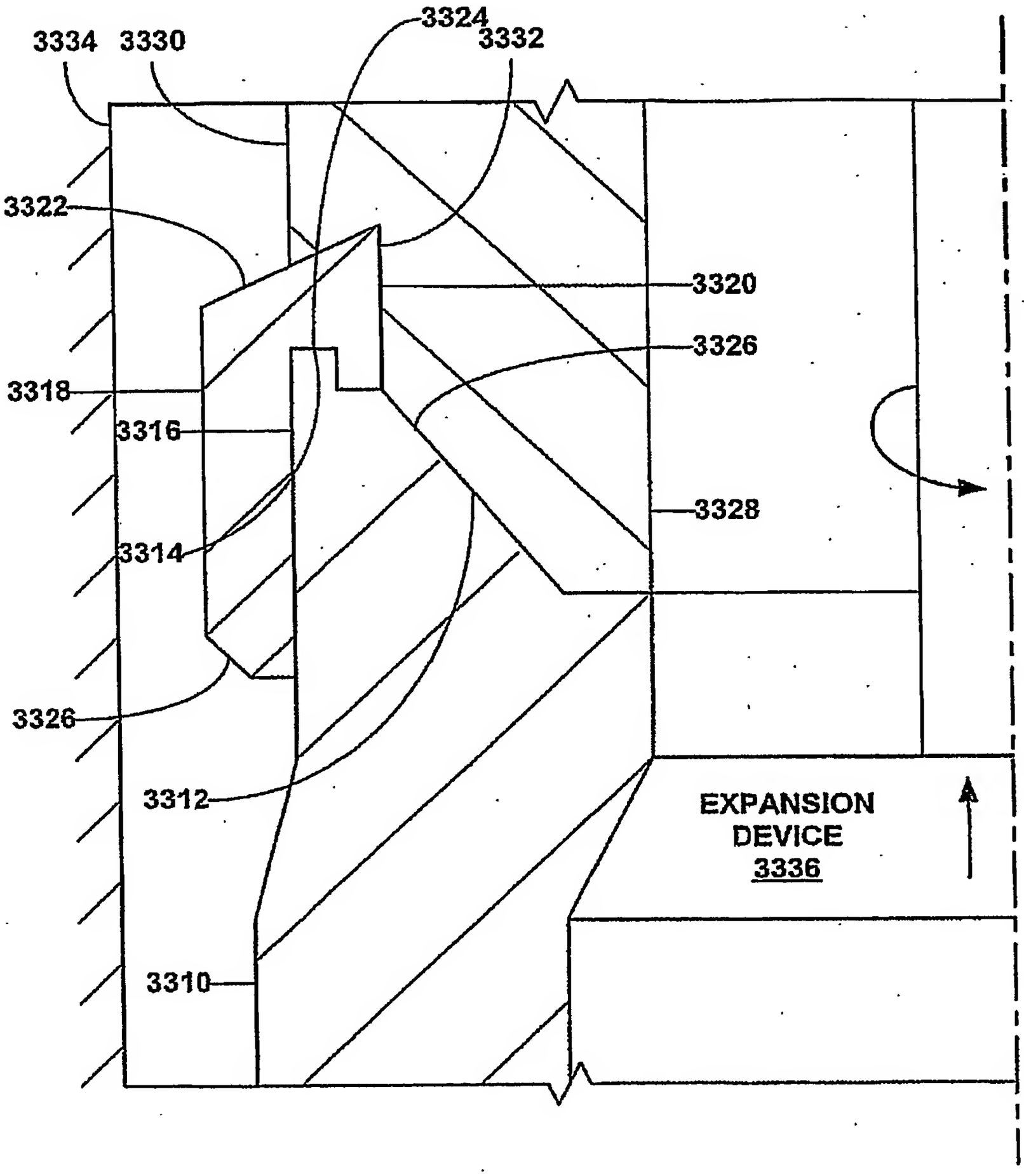
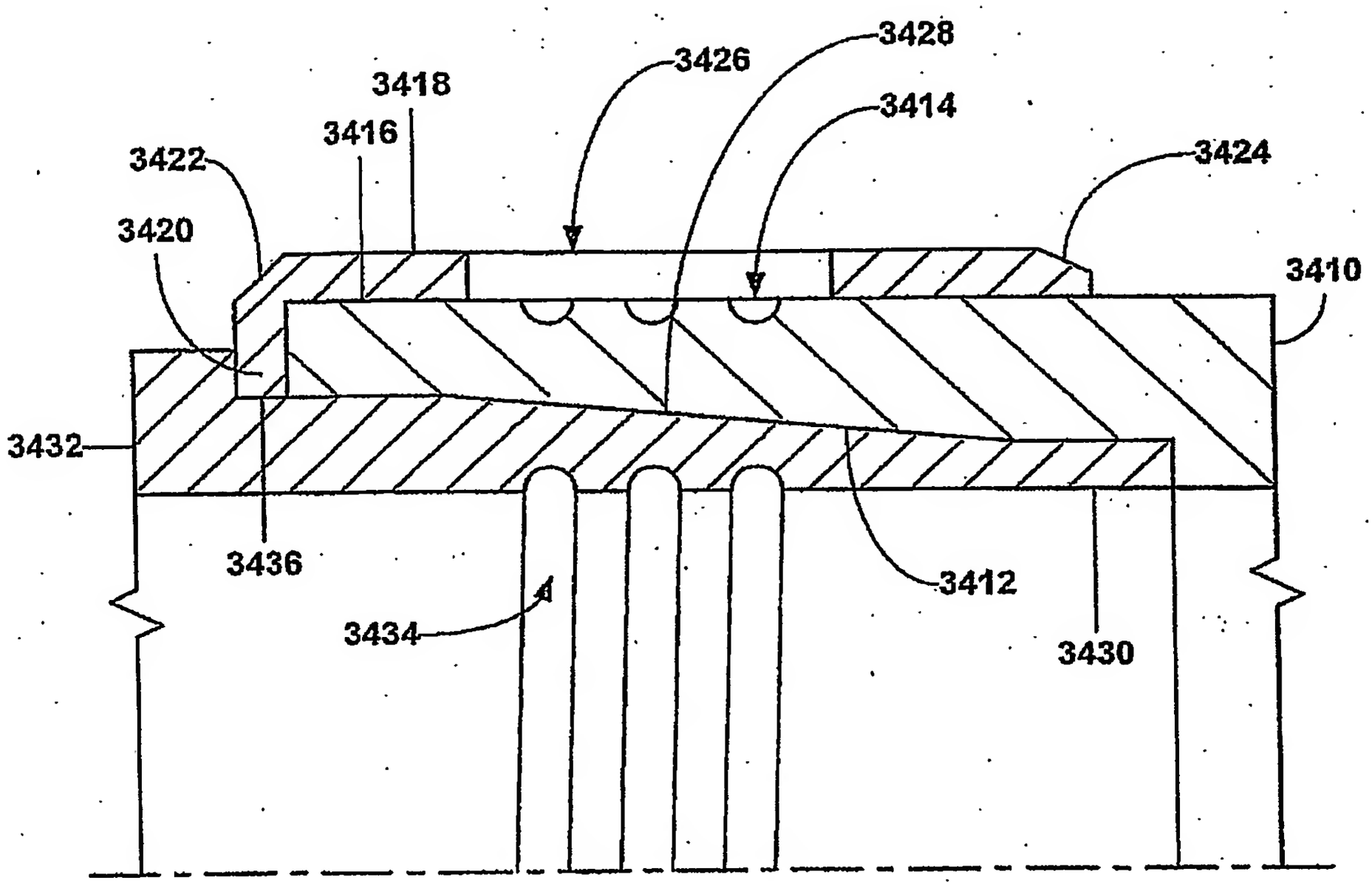

3334
3330
3324
3332
3322
3320
3326
3318
3316
3328
3314
3326
3312
EXPANSION
DEVICE
3336
3310

FIG. 33


3418
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3416
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3424
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3410
3432
3436
3412
3434
3430

FIG. 34a

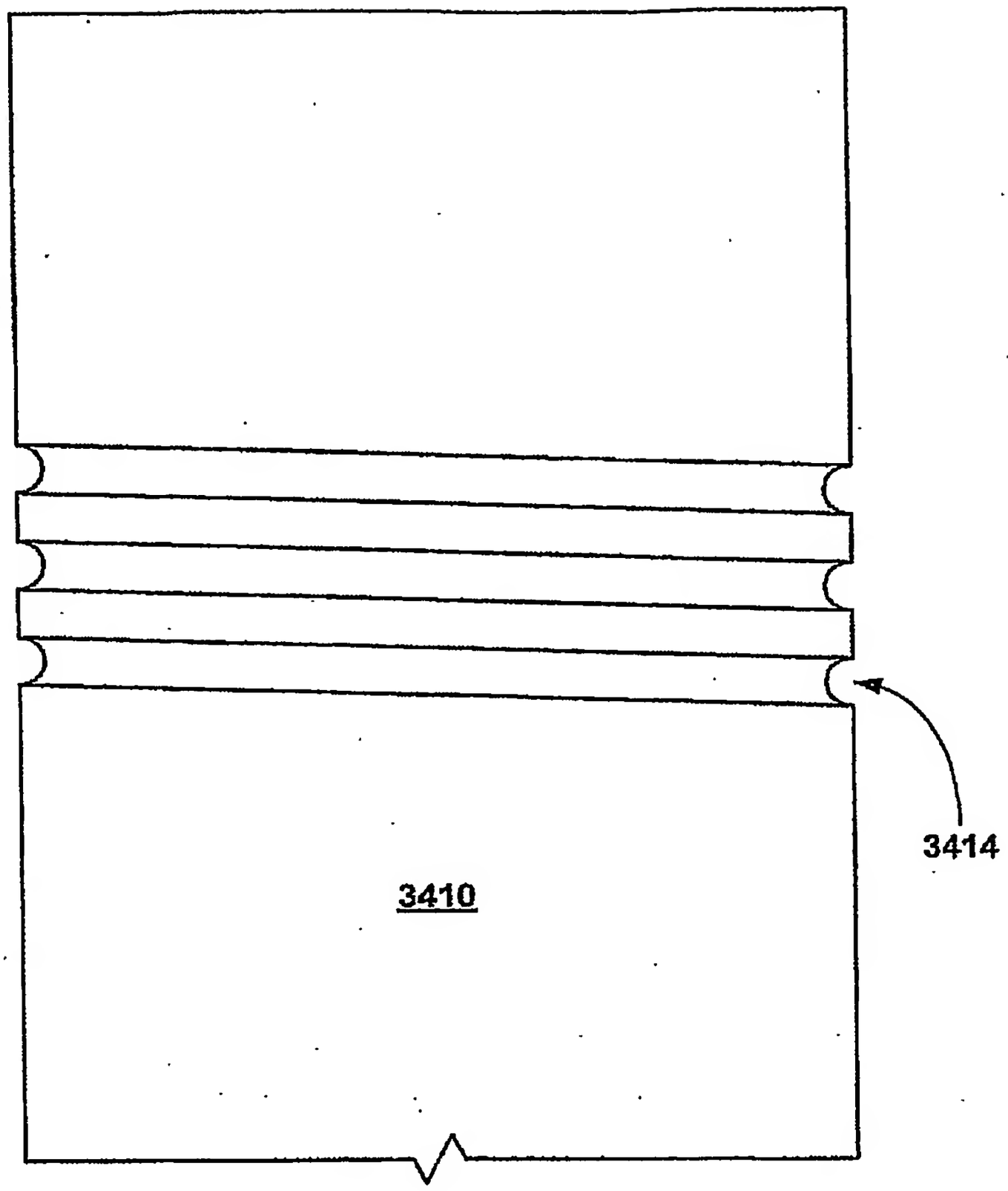

Fig. 34b

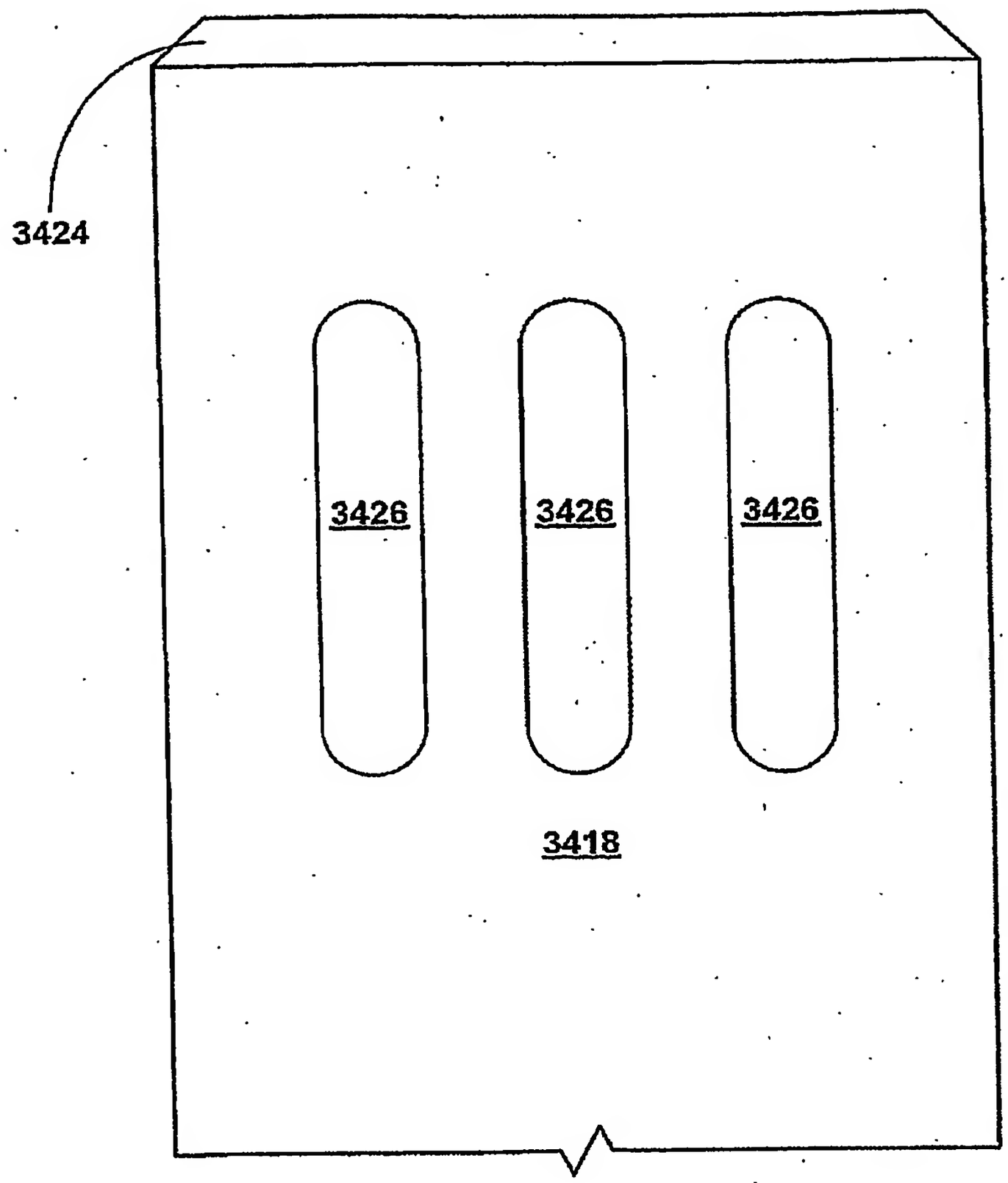

Fig. 34c

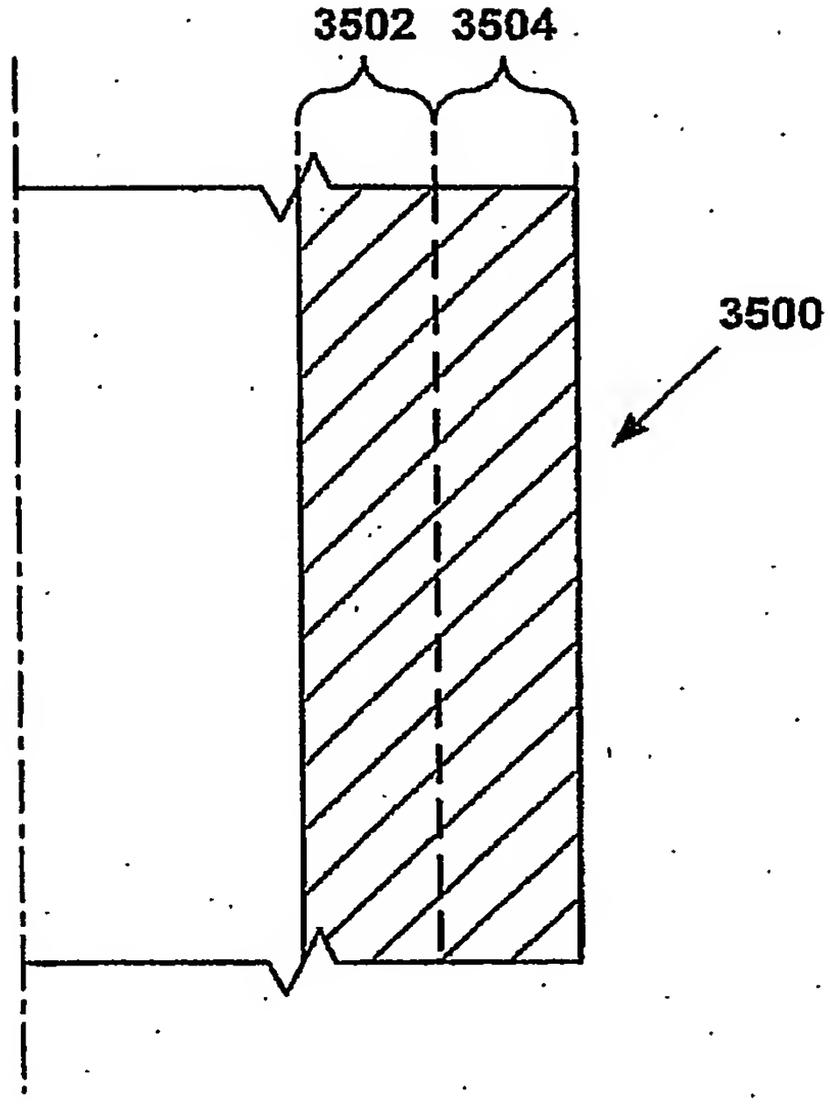

FIG. 35a

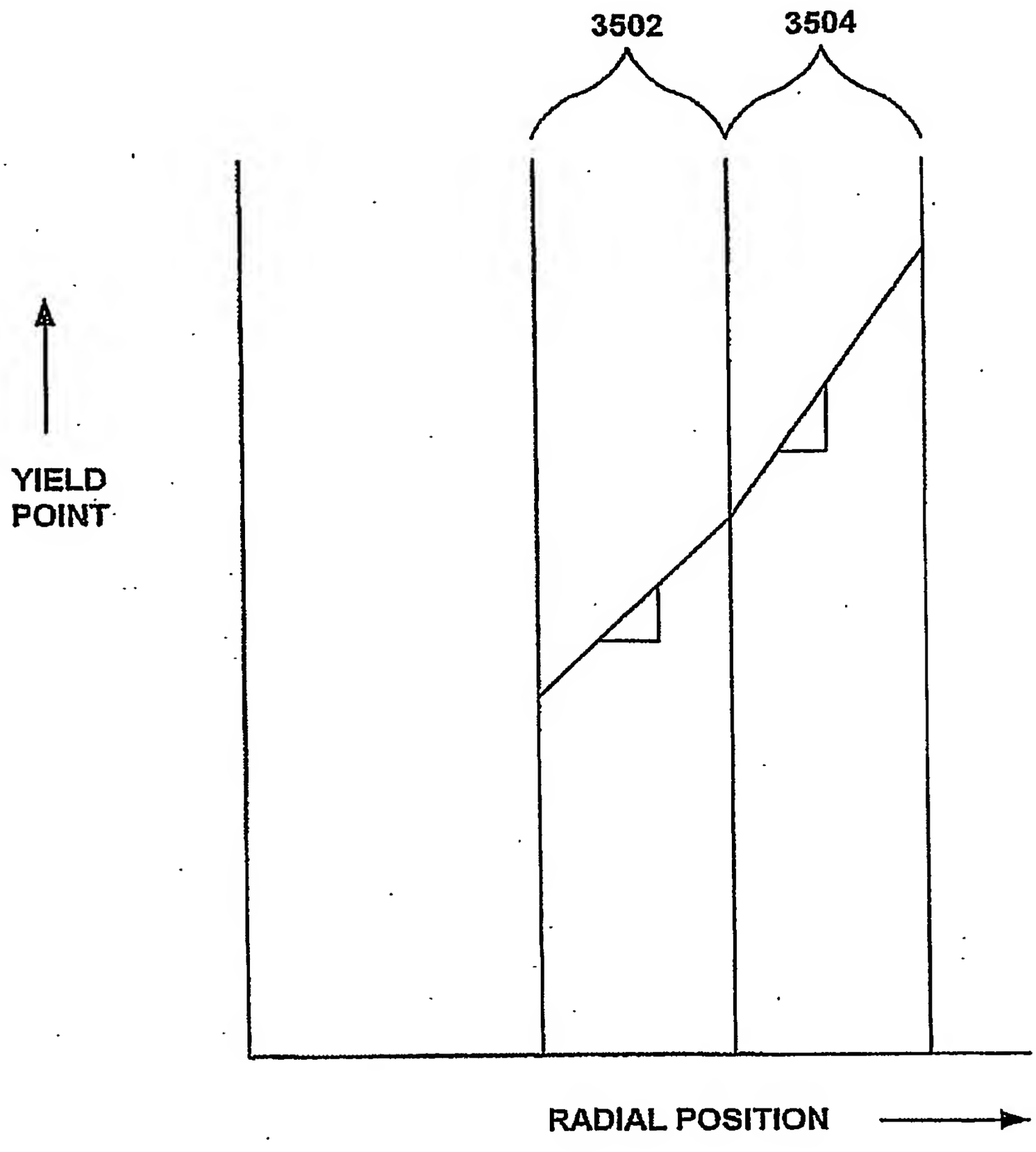

FIG. 35b

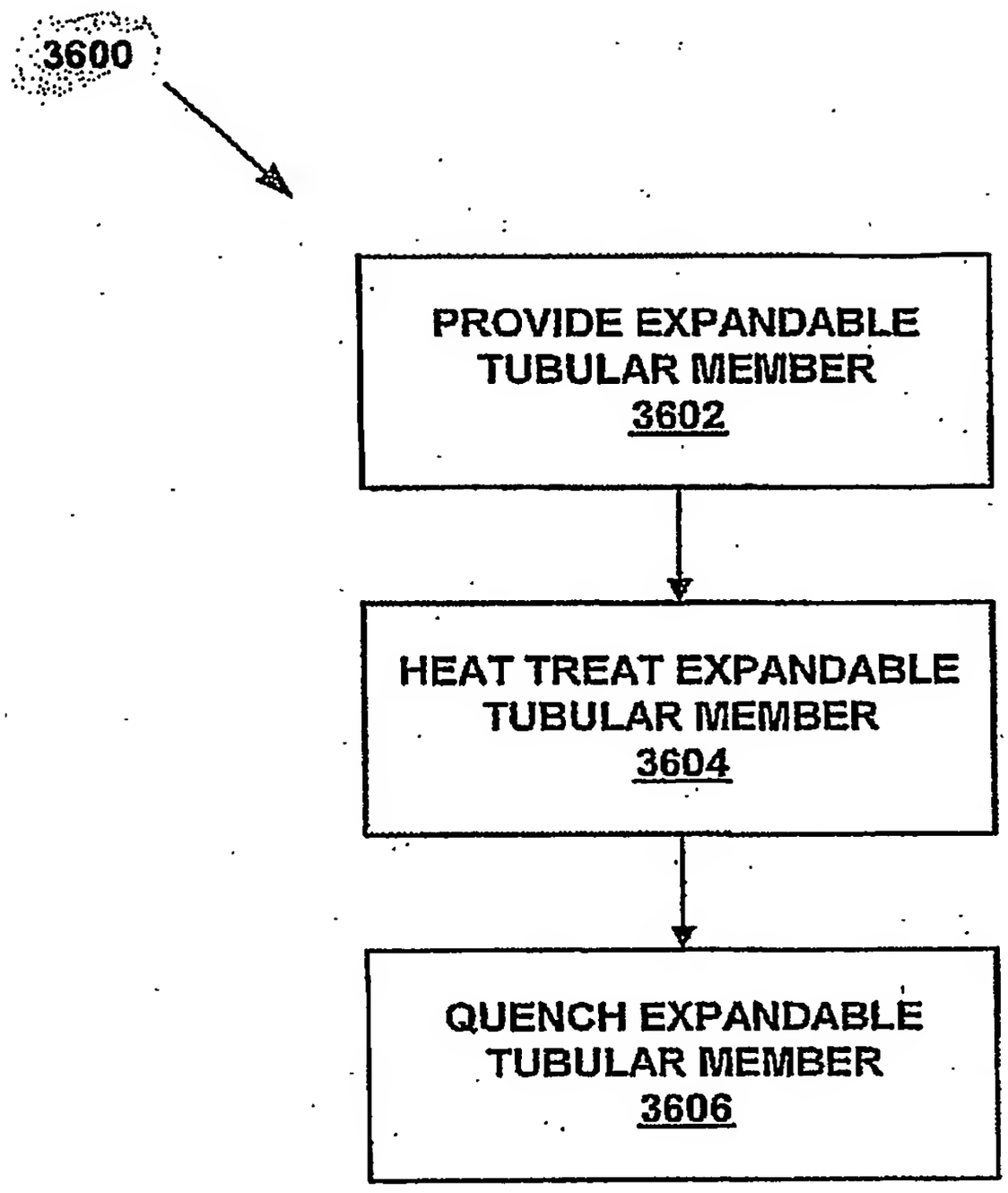
3600
PROVIDE EXPANDABLE TUBULAR MEMBER 3602
HEAT TREAT EXPANDABLE TUBULAR MEMBER 3604
QUENCH EXPANDABLE TUBULAR MEMBER 3606

FIG. 36a

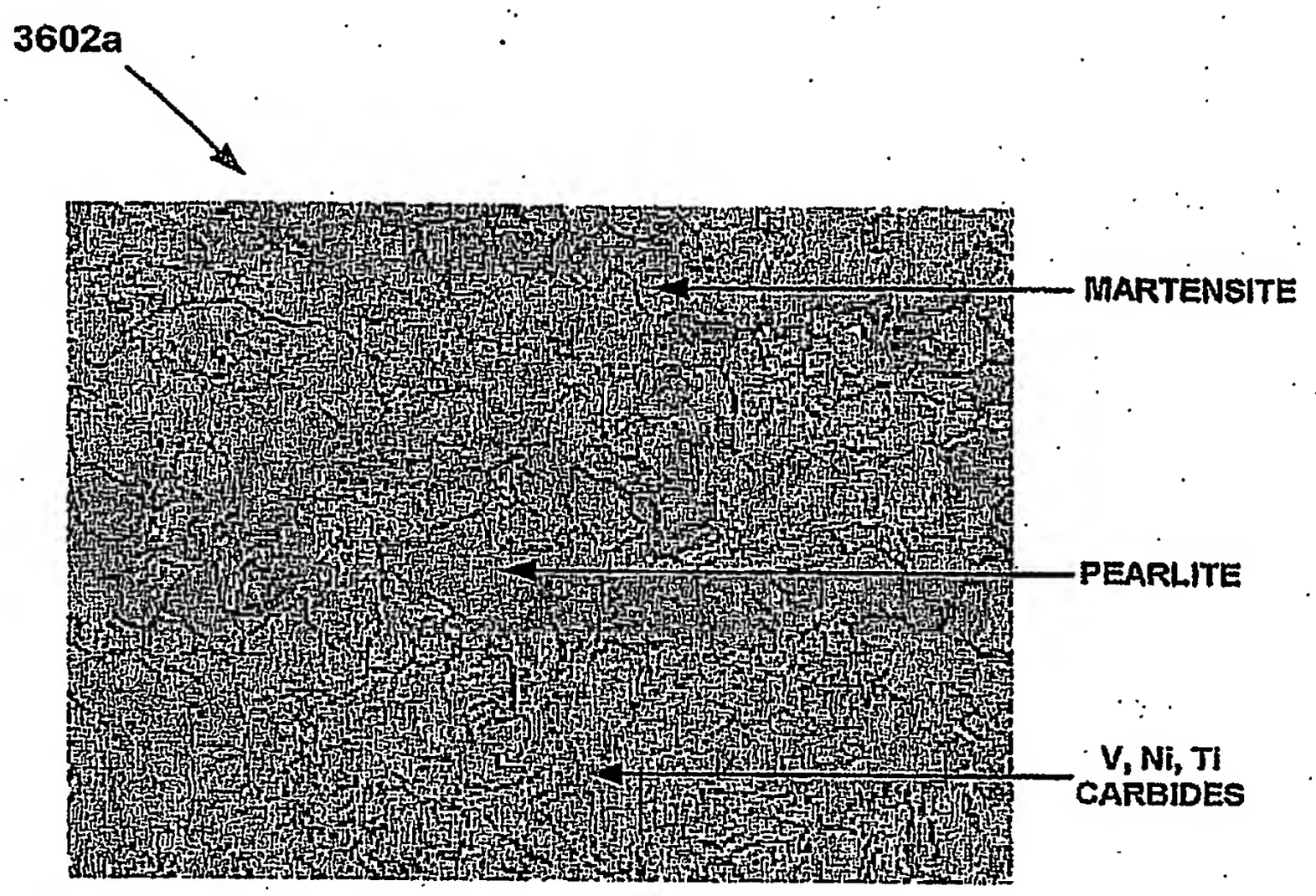

Fig. 36b

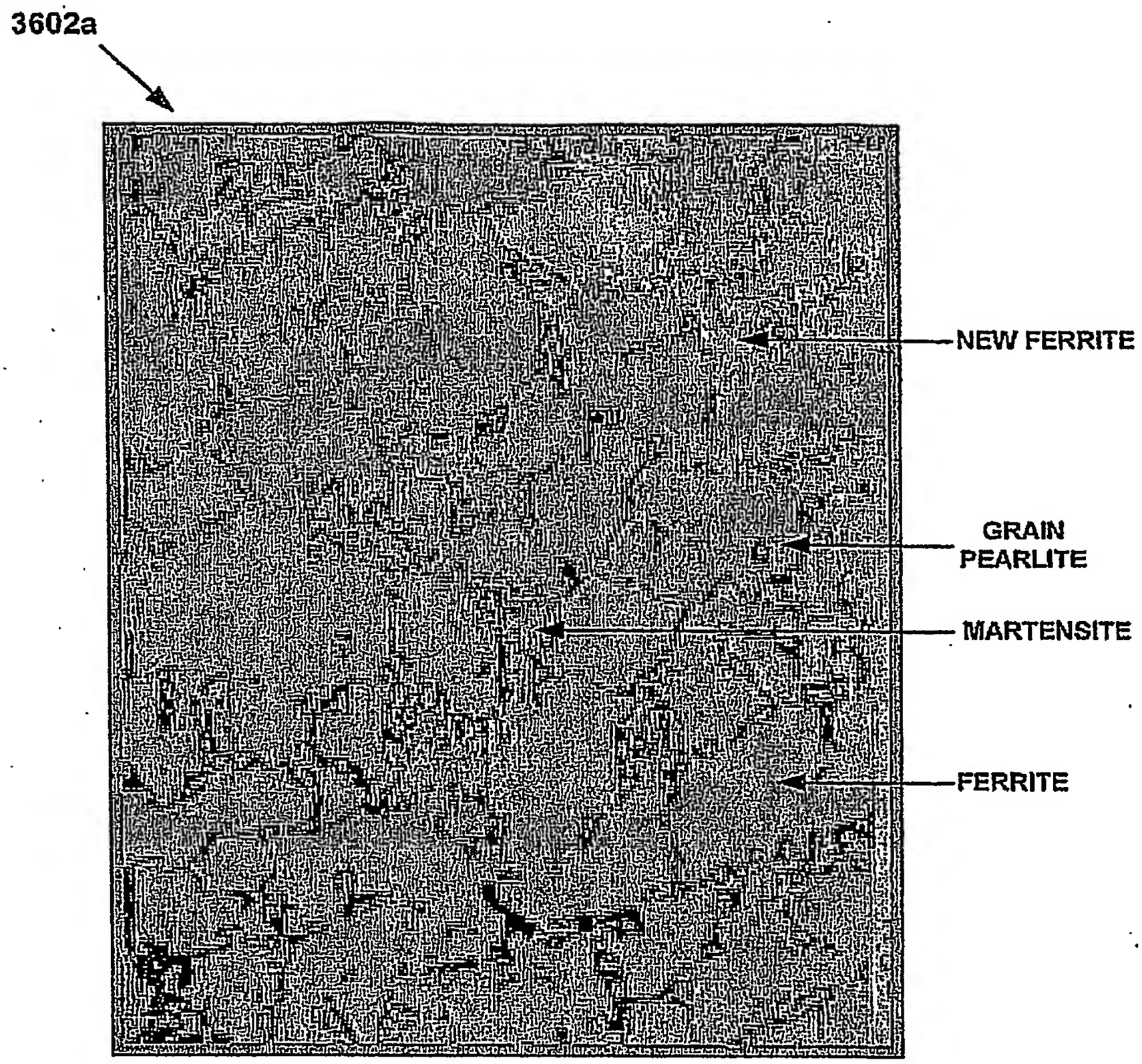

Fig. 36c

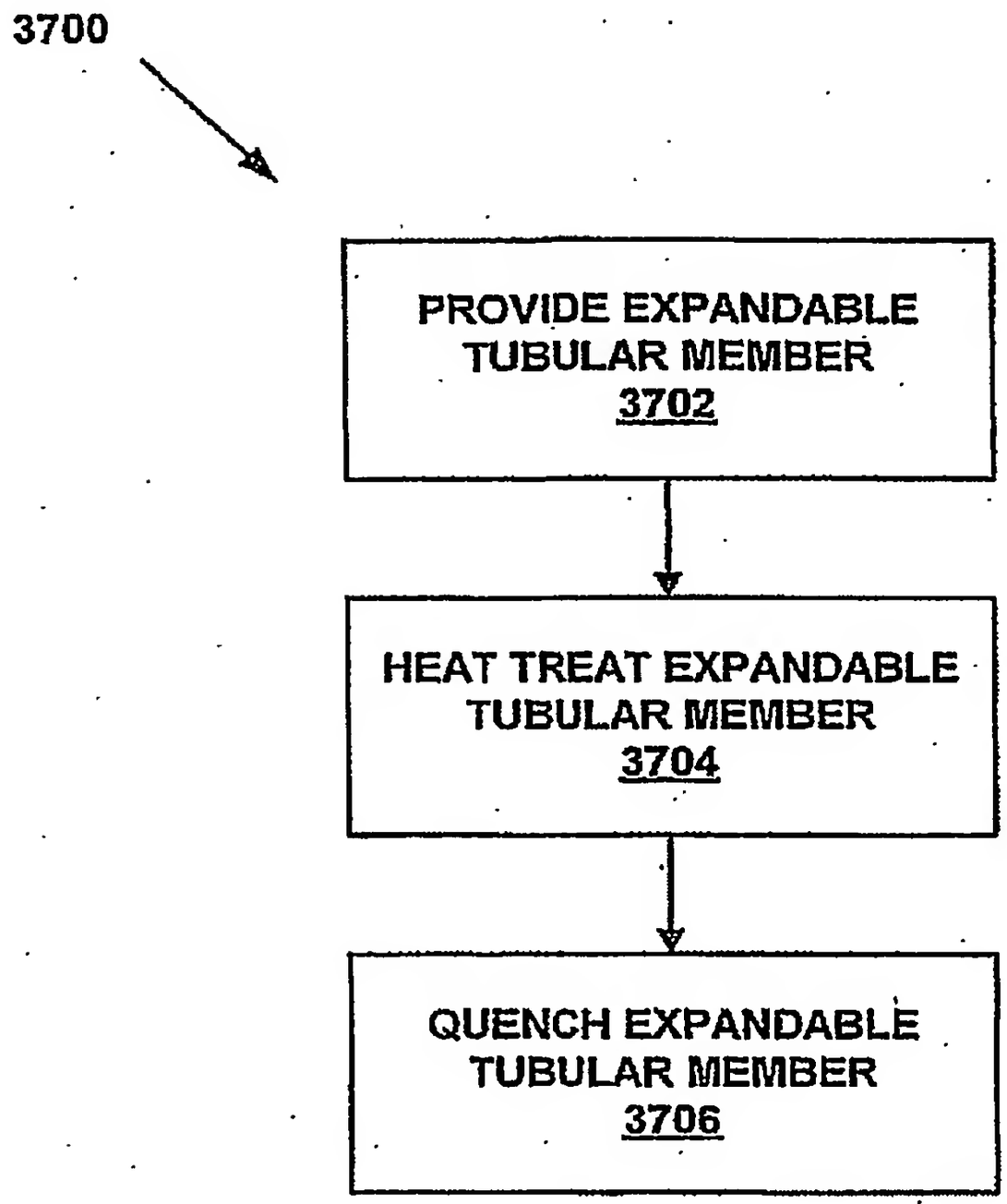
3700
PROVIDE EXPANDABLE TUBULAR MEMBER 3702
HEAT TREAT EXPANDABLE TUBULAR MEMBER 3704
QUENCH EXPANDABLE TUBULAR MEMBER 3706

FIG. 37a

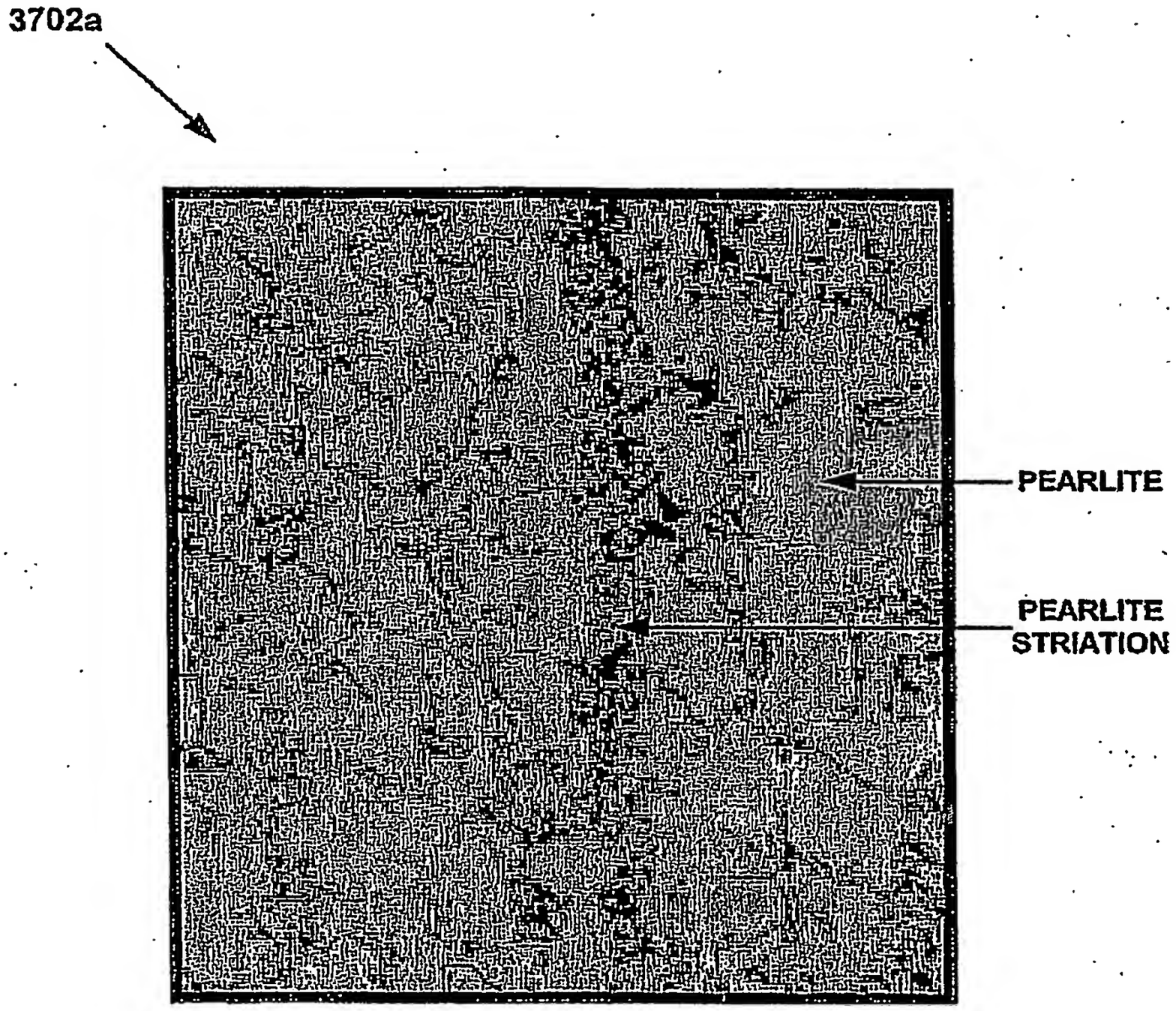

Fig. 37b

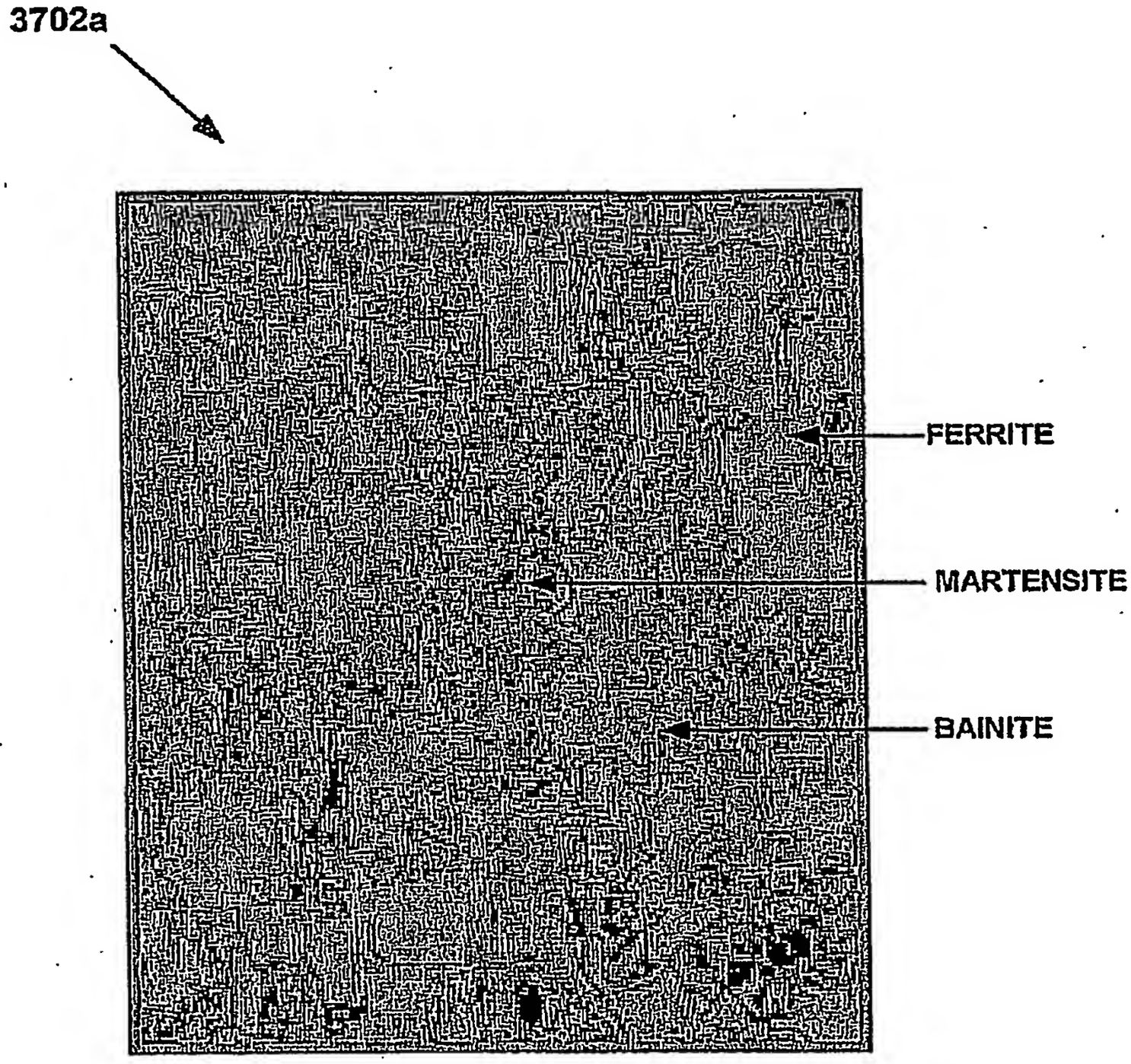

Fig. 37c

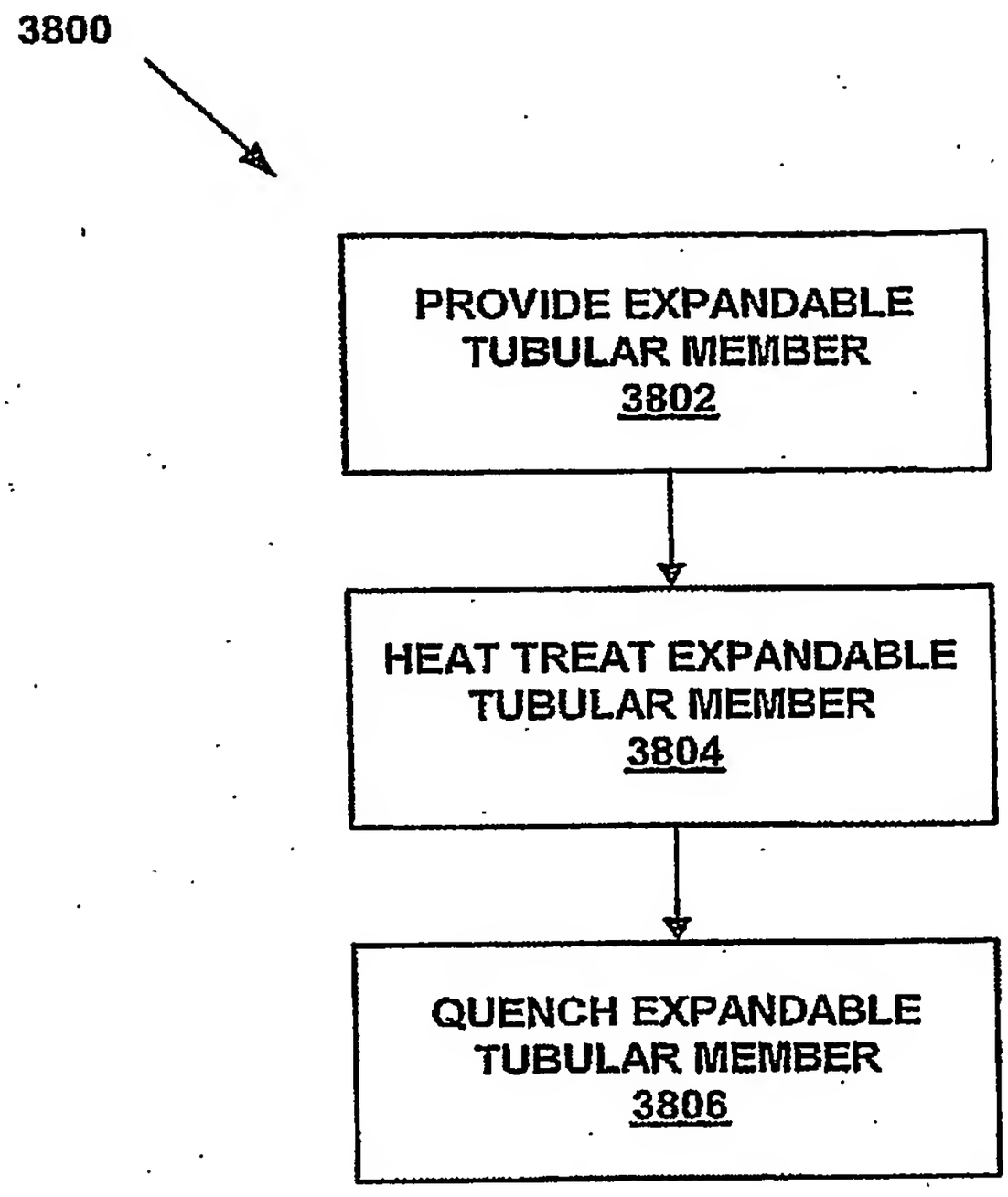
3800
PROVIDE EXPANDABLE TUBULAR MEMBER 3802
HEAT TREAT EXPANDABLE TUBULAR MEMBER 3804
QUENCH EXPANDABLE TUBULAR MEMBER 3806

FIG. 38a

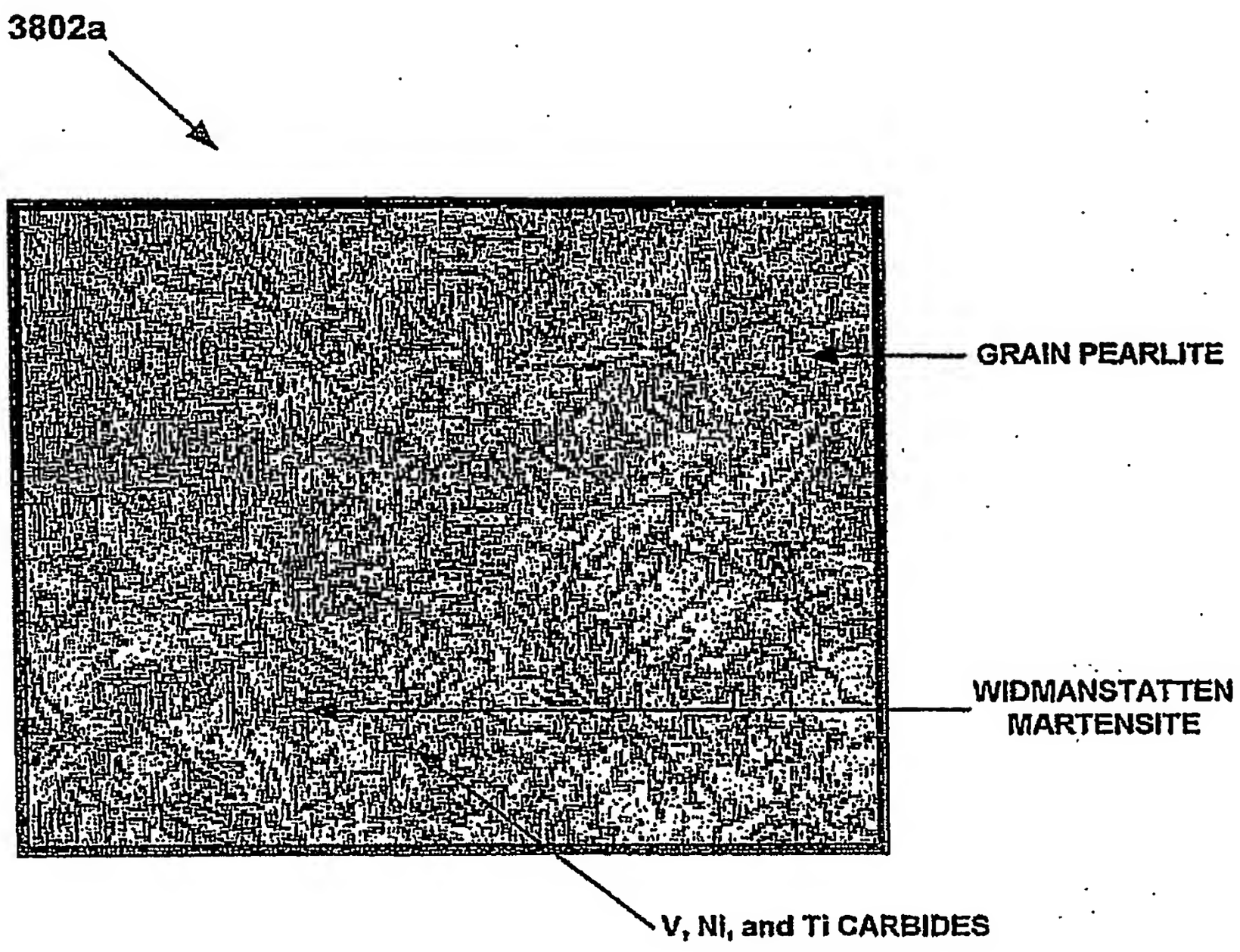
3802a
GRAIN PEARLITE
WIDMANSTATTEN MARTENSITE
V, Ni, and Ti CARBIDES

Fig. 38b

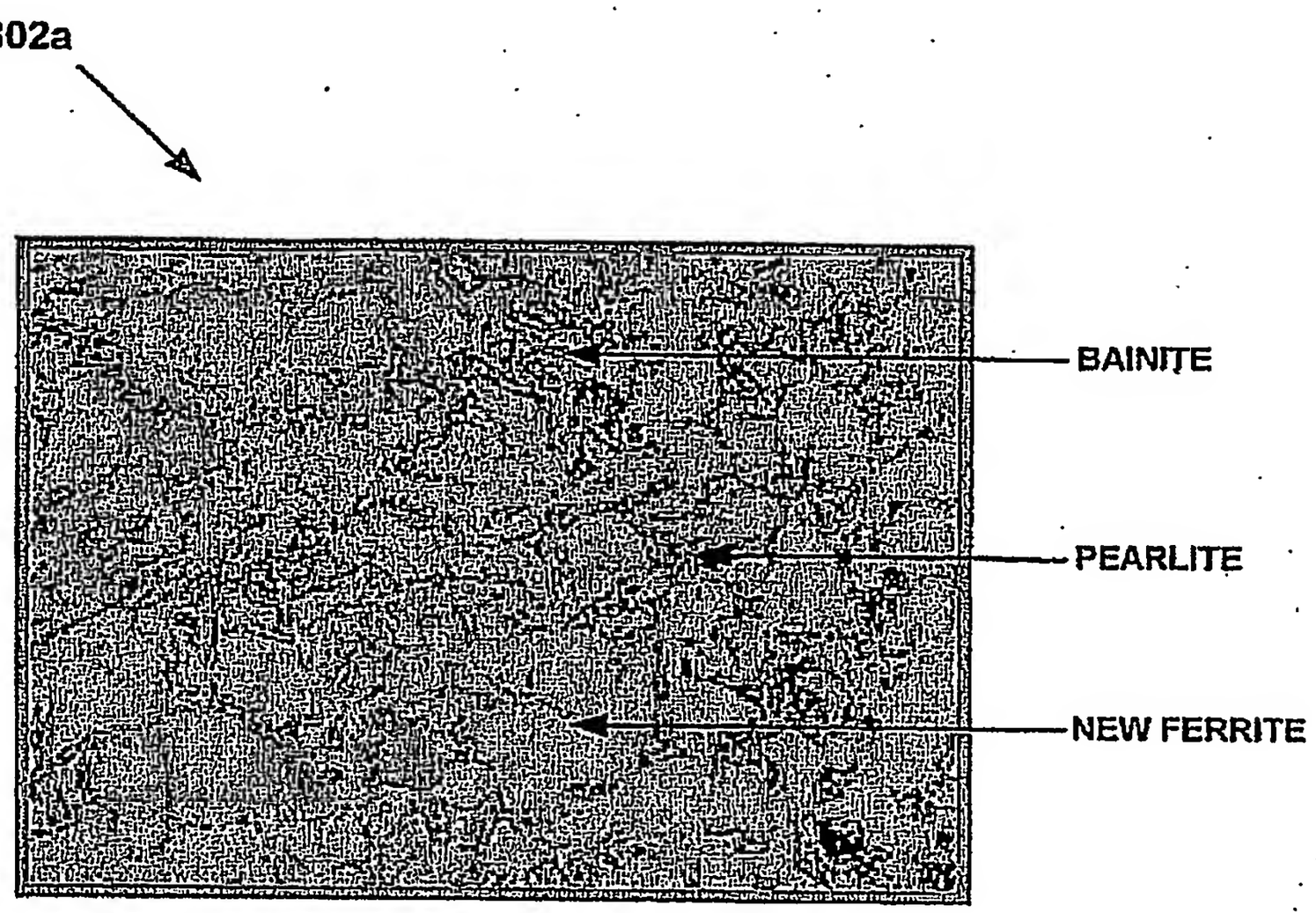

Fig. 38c

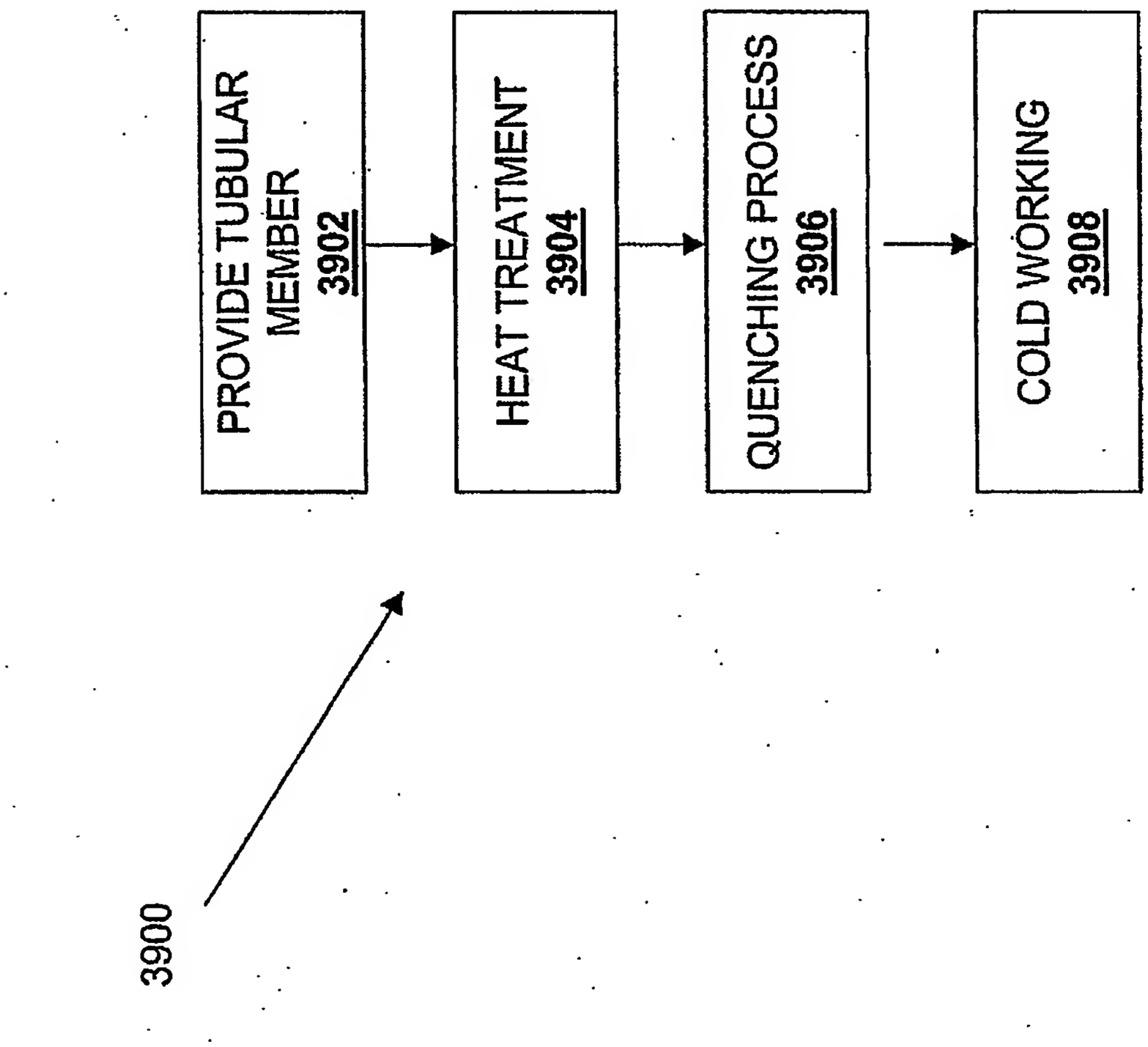
PROVIDE TUBULAR MEMBER
3902
HEAT TREATMENT
3904
QUENCHING PROCESS
3906
COLD WORKING
3908
3900

FIGURE 39

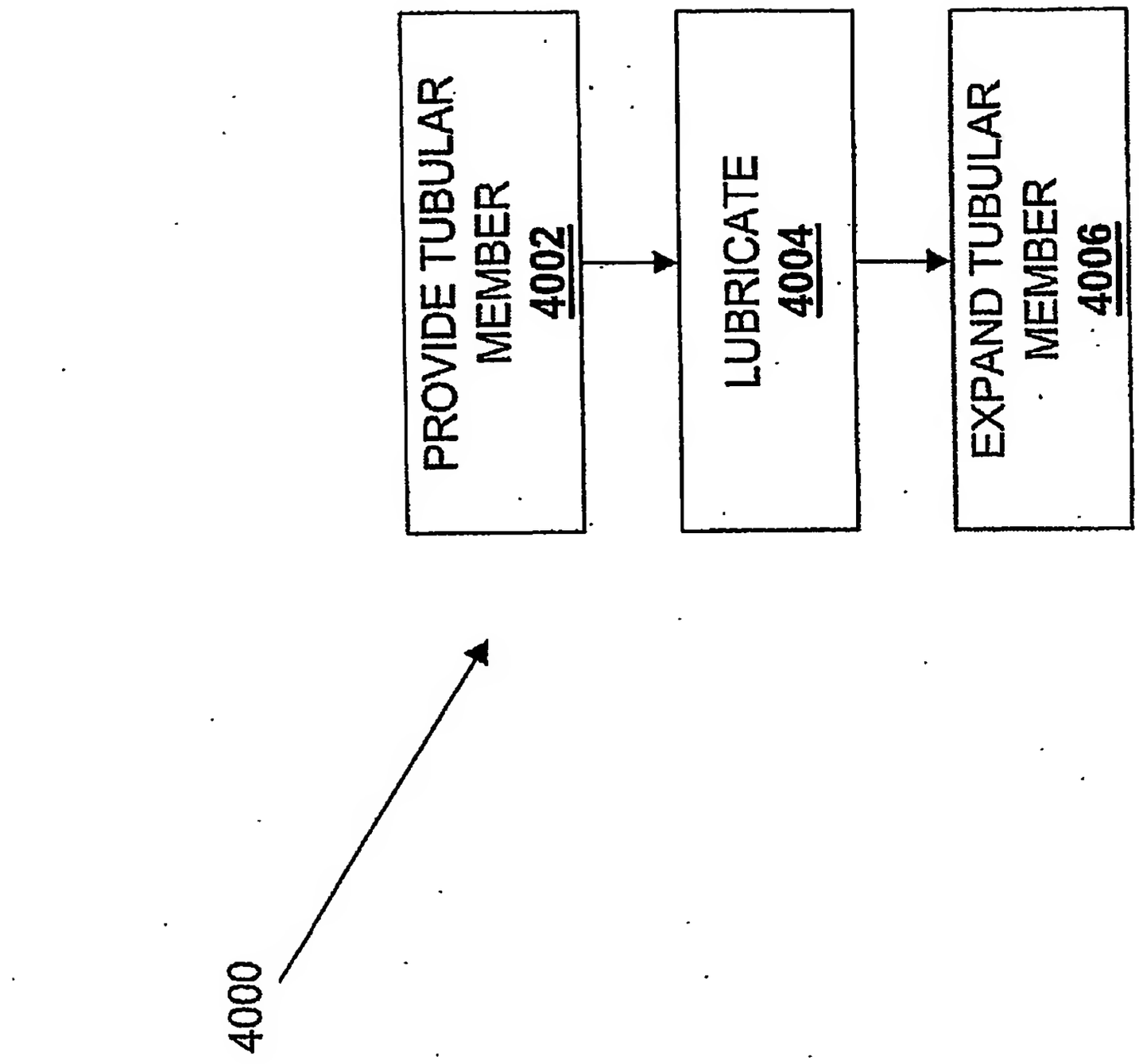
4000
PROVIDE TUBULAR MEMBER 4002
LUBRICATE 4004
EXPAND TUBULAR MEMBER 4006

FIGURE 40

Parameters Required for Formability Evaluation

4102

Stress-Strain Properties

- Optimum combination of the strength & elongation

4104

Charpy V-notch impact value

- Impact tests on notched specimens are used to predict the likelihood of brittle fracture

4106

Stress Rupture (burst, collapse)

- Higher strength is better but decreased ductility/toughness with increased susceptibility to environmental cracking

4108

Strain-hardening exponent (n - value)

- Material with higher strain-hardening exponent can avoid failure during tube expansion

4110

Plastic strain ratio (r or Lankford - value)

- The ratio of the strains occurring in the width and thickness directions. In case greater than 1.0 will be more resistant to thinning and better suited to tubular expansion

4100

ENVENTURE
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FIGURE 41

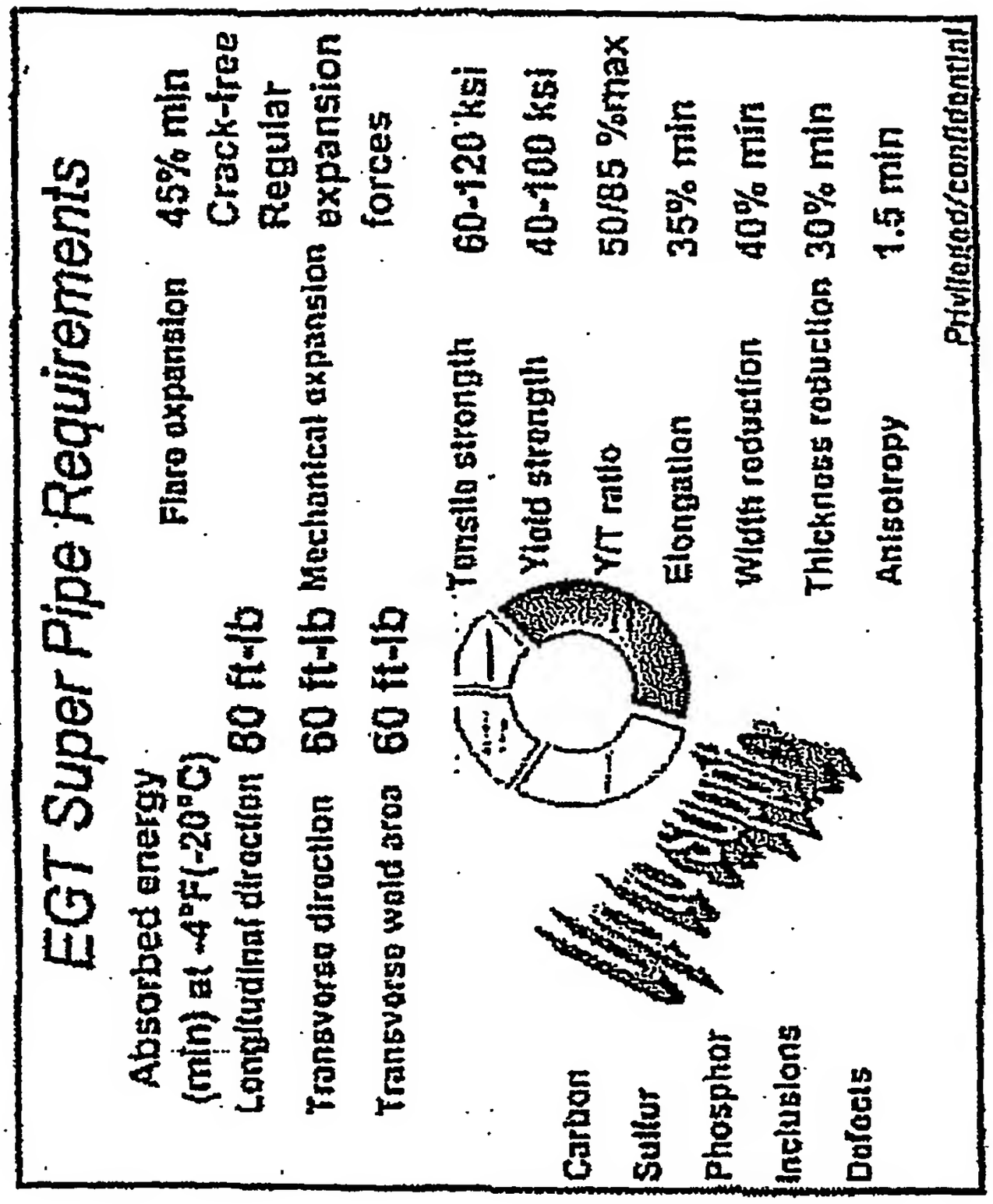

EGT Super Pipe Requirements
Absorbed energy (min) at -4°F(-20°C)
Longitudinal direction 80 ft-lb
Transverse direction 60 ft-lb
Transverse weld area 60 ft-lb
Flare expansion 45% min
Crack-free
Regular
Mechanical expansion expansion
forces
Tensile strength 60-120 ksi
Yield strength 40-100 ksi
Y/T ratio 50/85 %max
Elongation 35% min
Width reduction 40% min
Thickness reduction 30% min
Anisotropy 1.5 min
Carbon
Sulfur
Phosphor
Inclusions
Defects
Privileged/confidential
4200

FIGURE 42

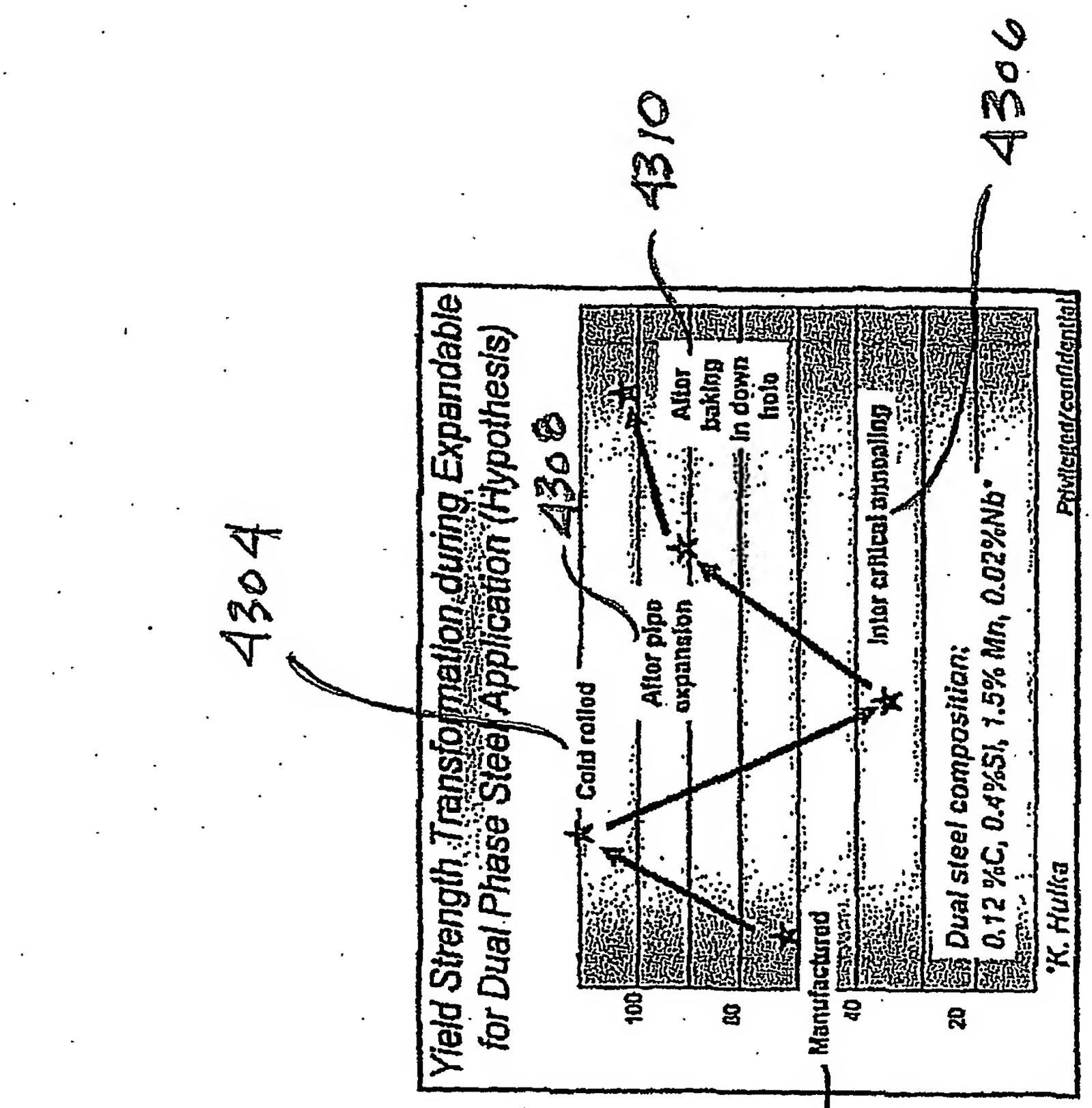

4304
4310
4306
4308
4302
4300
Yield Strength Transformation during Expandable for Dual Phase Steel Application (Hypothesis)
Cold rolled
After pipe expansion
After baking in down hole
Inter critical annealing
Manufactured
Dual steel composition:
0.12 %C, 0.4%Si, 1.5% Mn, 0.02%Nb*
*K. Hulka
Proprietary/confidential
100
80
40
20

FIGURE 43

EGT Pipe Requirements

Absorbed energy (min) at -4°F(-20°C)	
Longitudinal direction	80 ft-lb
Transverse direction	60 ft-lb
Transverse weld area	60 ft-lb

Flare expansion	45% min
Mechanical expansion	Crack-free, Regular expansion forces

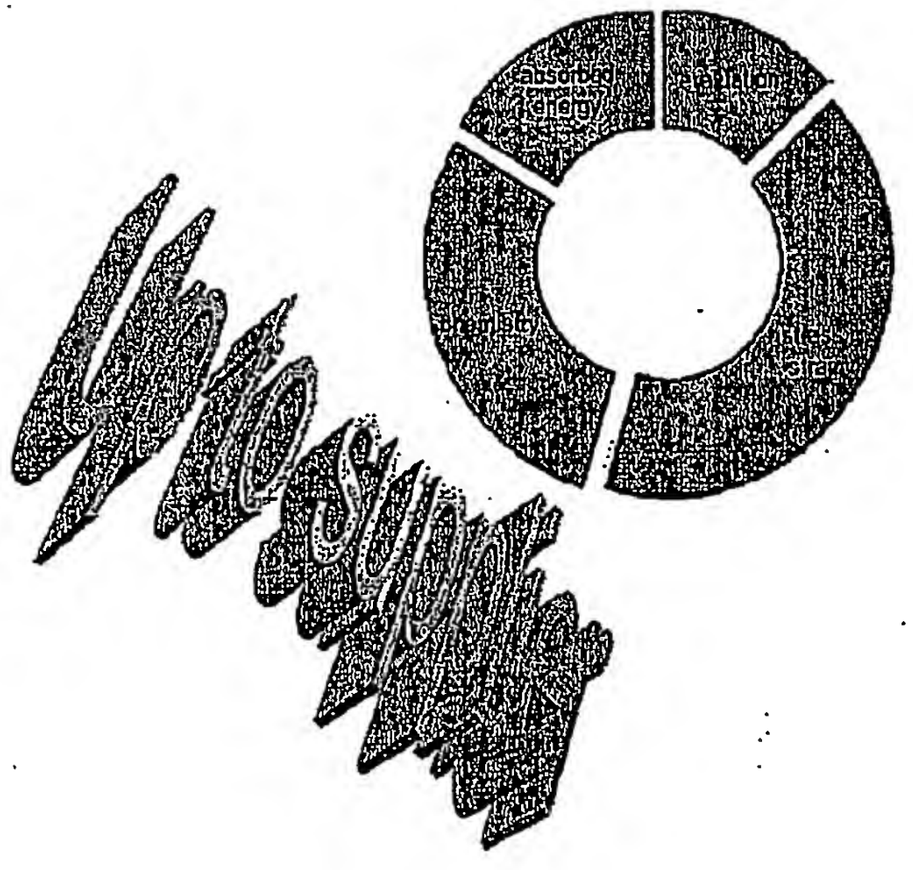
Carbon

Sulfur

Phosphor

Inclusions

Defects



Tensile strength	80-100 ksi
Yield strength	60-90 ksi
Y/T ratio	85 %max
Elongation	22% min
Width reduction	30% min
Thickness reduction	35% min
Anisotropy	0.8 min

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4400

FIGURE 44

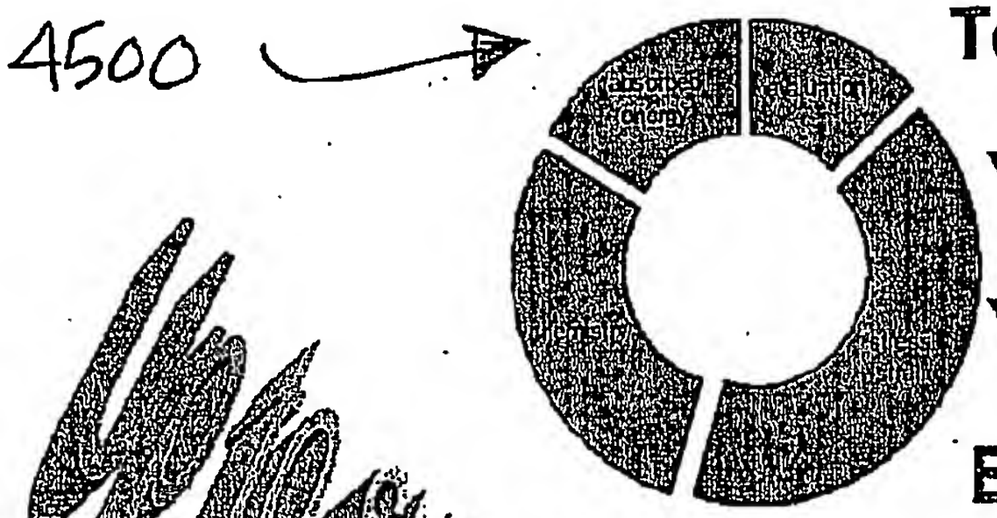
WO 2005/017303
PCT/US2004/026345

EGT Super Pipe Requirements

Absorbed energy (min) at -4°F(-20°C)

Longitudinal direction	80 ft-lb
Transverse direction	60 ft-lb
Transverse weld area	60 ft-lb

4500



Carbon

Sulfur

Phosphor

Inclusions

Defects

Ultra Strength

ENVENTURE
SET. The Standard.™

Flare expansion	75% min Crack-free
Mechanical expansion	Regular expansion forces
Tensile strength	60-120 ksi
Yield strength	40-100 ksi
Y/T ratio	50/85 %max
Elongation	35% min
Width reduction	40% min
Thickness reduction	30% min
Anisotropy	1.5 min

Privileged/confidential

FIGURE 45

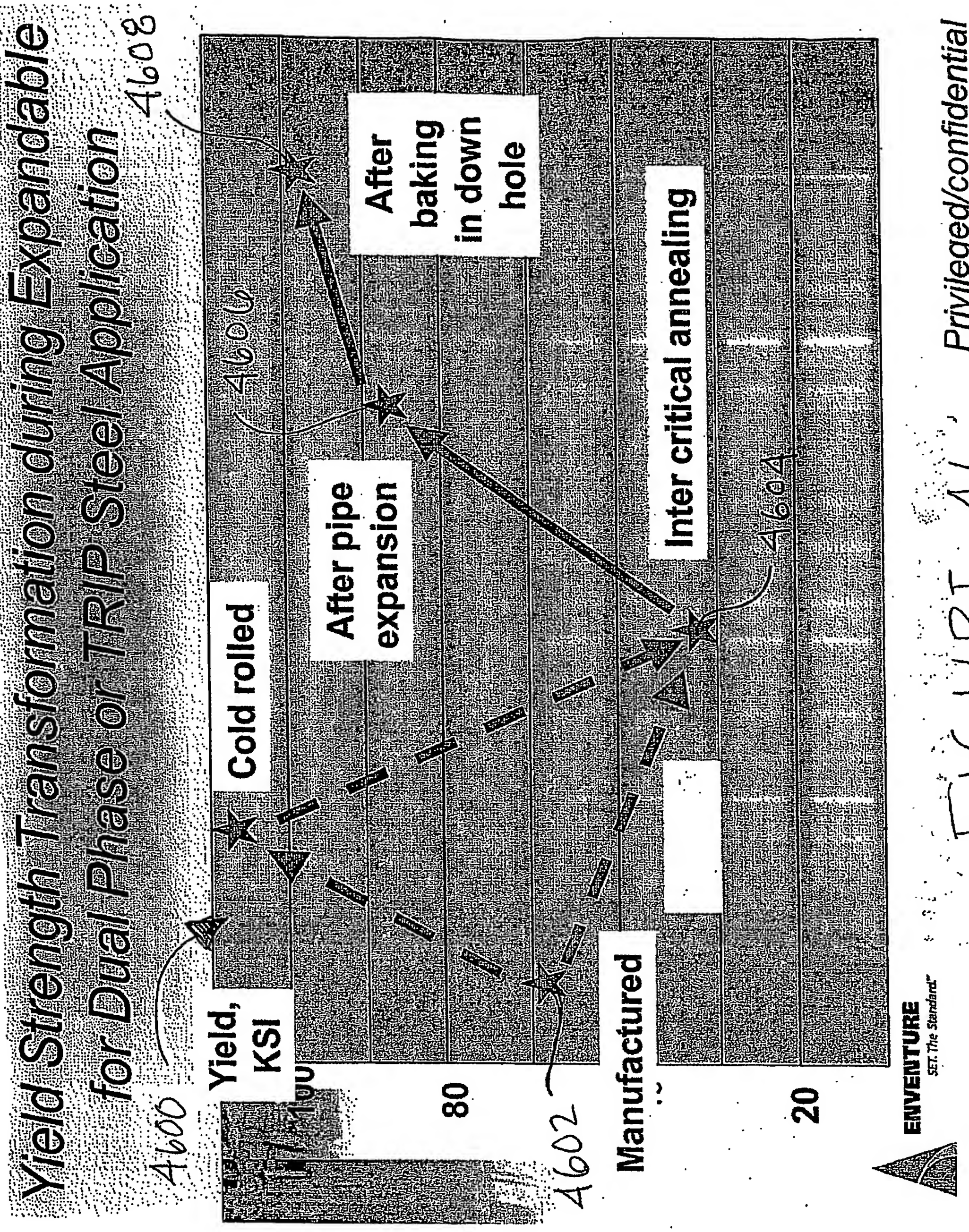

Yield Strength Transformation during Expandable
for Dual Phase or TRIP Steel Application
4608
After baking in down hole
After pipe expansion
Cold rolled
Inter critical annealing
Manufactured
Yield, KSI
80
20
4600
4602
4604
ENVENTURE
SET: The Standard™
Privileged/confidential

FIGURE 46

"History" Pipe Performance*

(High speed tube welding and optimum reducing technology)

- New metallurgy
- Warm-reducing new manufacturing process
- High strength & excellent formability
- 20 % higher elongation
- High r-value (=strain in different directions)

4700

	Yield, ksi	Tensile ksi	Elongation %
"History" pipe	76.8	82.8	32
ERW pipe	64.8	85.0	18

ENVENTURE
SET. The Standard.™

FIGURE 47

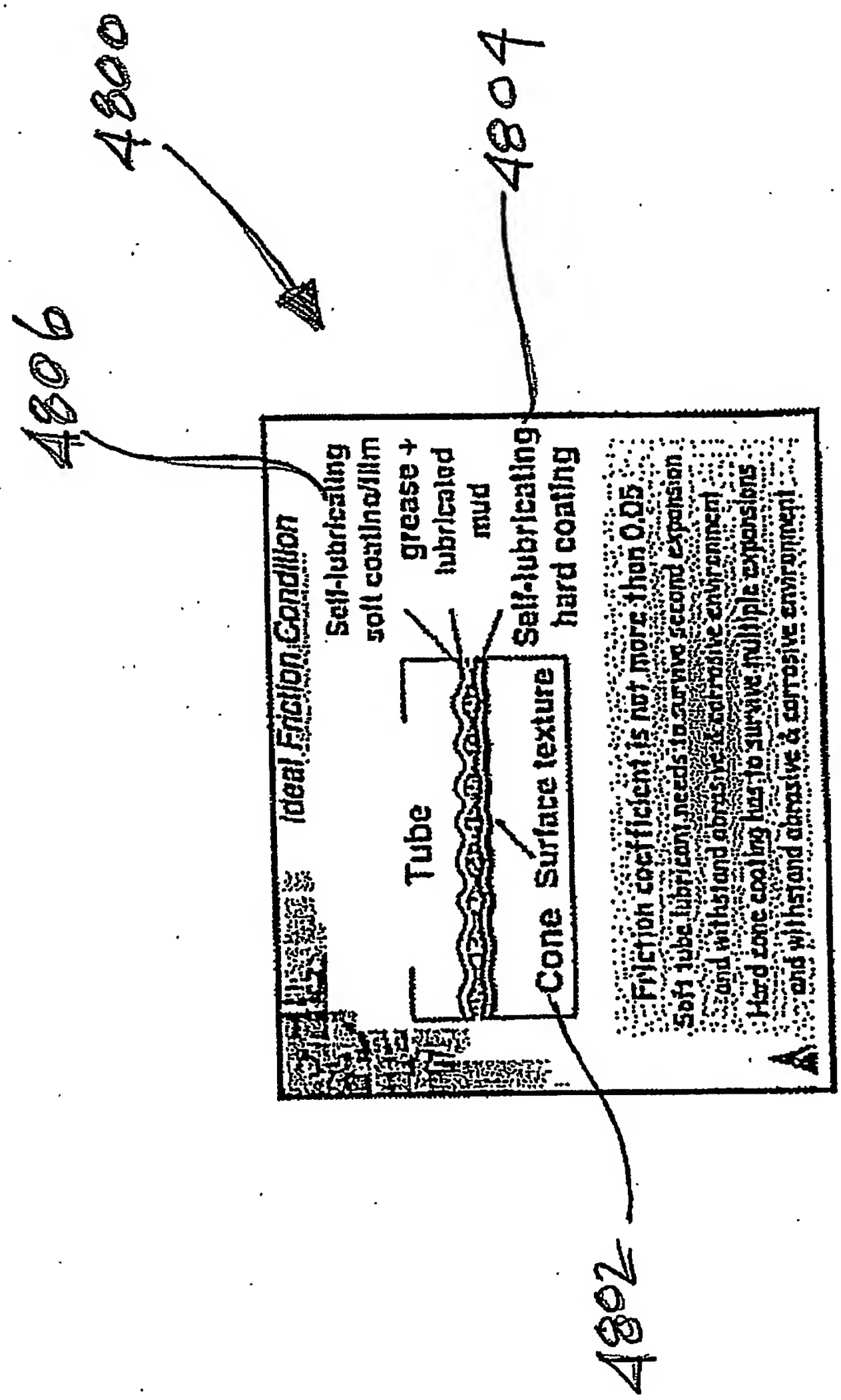

4800
4804
4806
4802
Ideal Friction Condition
Self-lubricating soft coating/film
grease + lubricated mud
Self-lubricating hard coating
Tube
Cone
Surface texture
Friction coefficient is not more than 0.05
Soft tube lubricant needs to survive second expansion
and withstand abrasive & corrosive environment
Hard cone coating has to survive multiple expansions
and withstand abrasive & corrosive environment

FIGURE 48

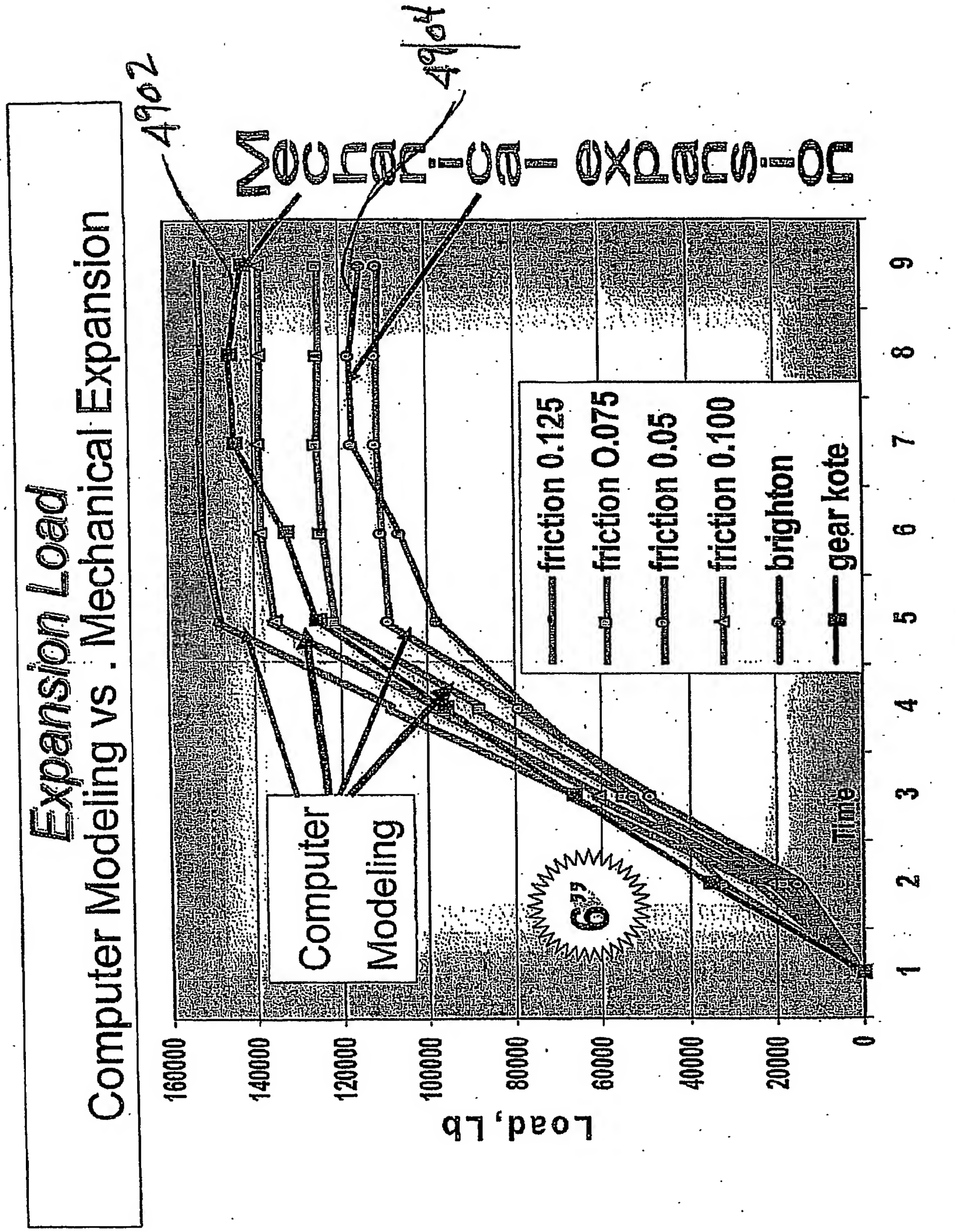
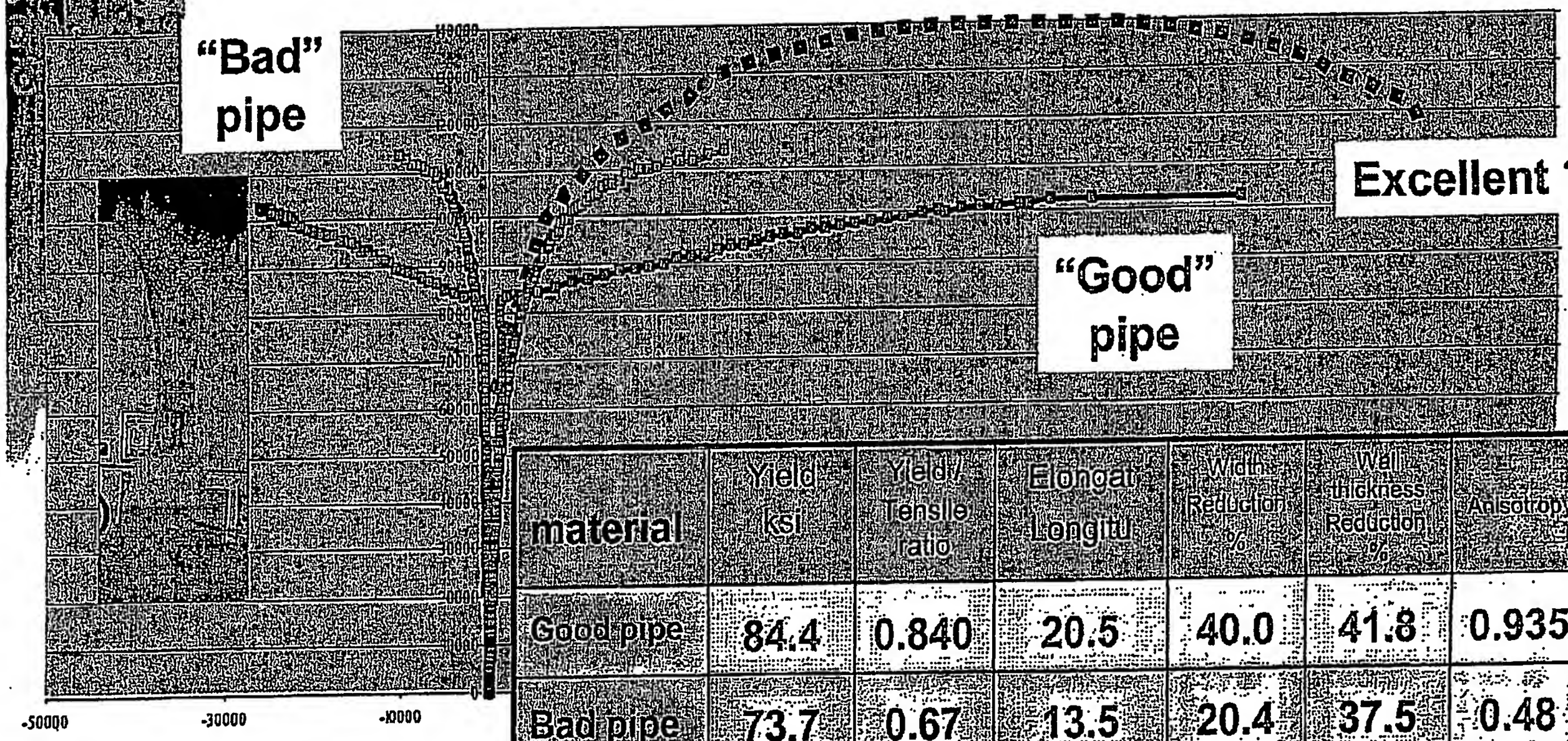

Expansion Load
Computer Modeling vs . Mechanical Expansion
Computer Modeling
Mechanical Expansion
Load, Lb
Time
friction 0.125
friction 0.075
friction 0.05
friction 0.100
brighton
gear kote
160000
140000
120000
100000
80000
60000
40000
20000
0
1
2
3
4
5
6
7
8
9

FIGURE 49

Engineering Stress vs. Strain Curve



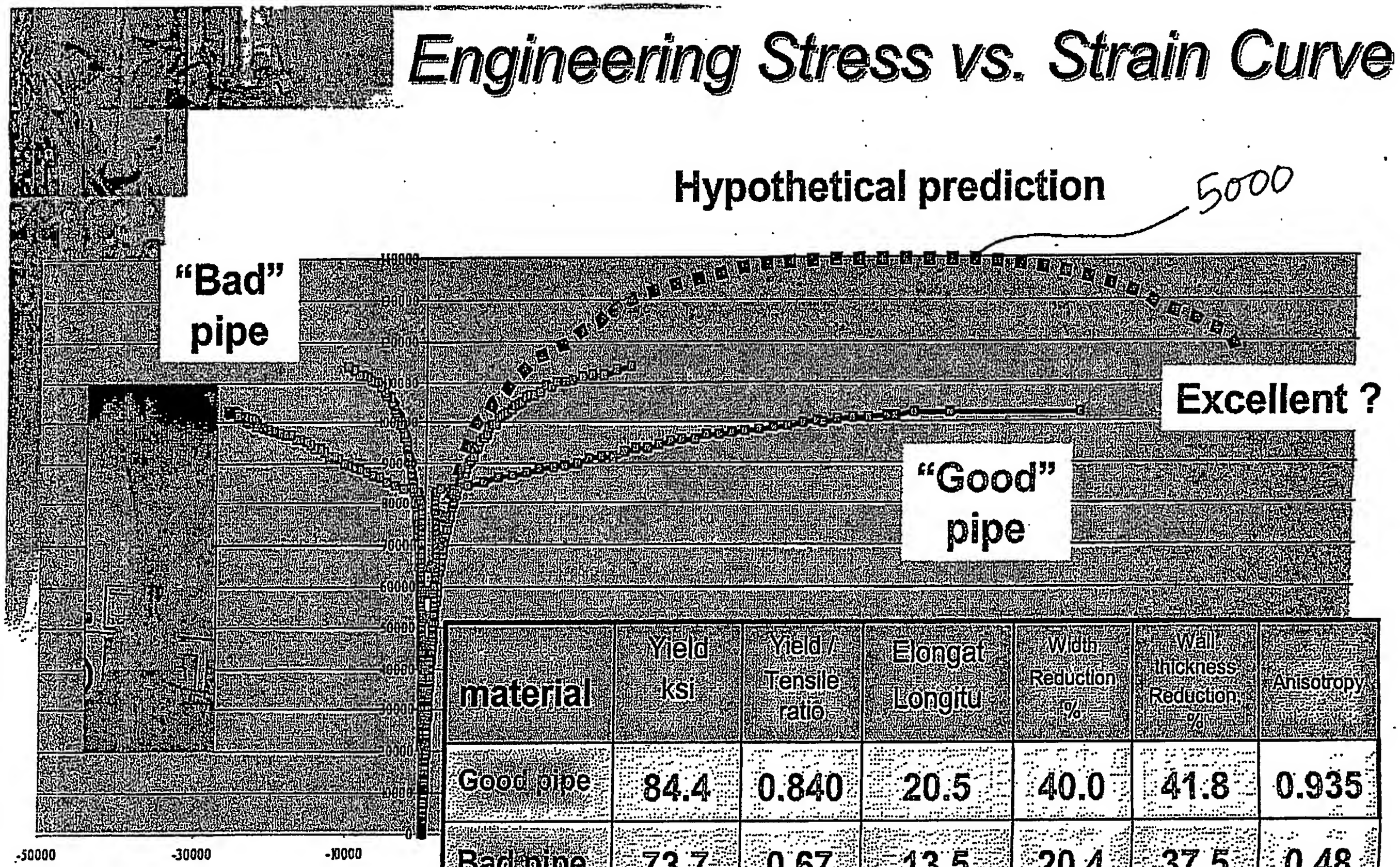
material	Yield ksi	Yield/ Tensile ratio	Elongat Longitu	Width Reduction %	Wal thickness Reduction %	Anisotropy
Good pipe	84.4	0.840	20.5	40.0	41.8	0.935
Bad pipe	73.7	0.67	13.5	20.4	37.5	0.48
Excellent	40/80	<0.5	>30	>45	>30	>1.5

5000

ENVENTURE
SET. The Standard.™

FIGURE 50a

Engineering Stress vs. Strain Curve



material	Yield ksi	Yield / Tensile ratio	Elongat Longitu	Width Reduction %	Wall thickness Reduction %	Anisotropy
Good pipe	84.4	0.840	20.5	40.0	41.8	0.935
Bad pipe	73.7	0.67	13.5	20.4	37.5	0.48
Excellent	40/80	<0.5	>30	>45	>30	>1.5

ENVENTURE
SET. The Standard.™

FIGURE 5b

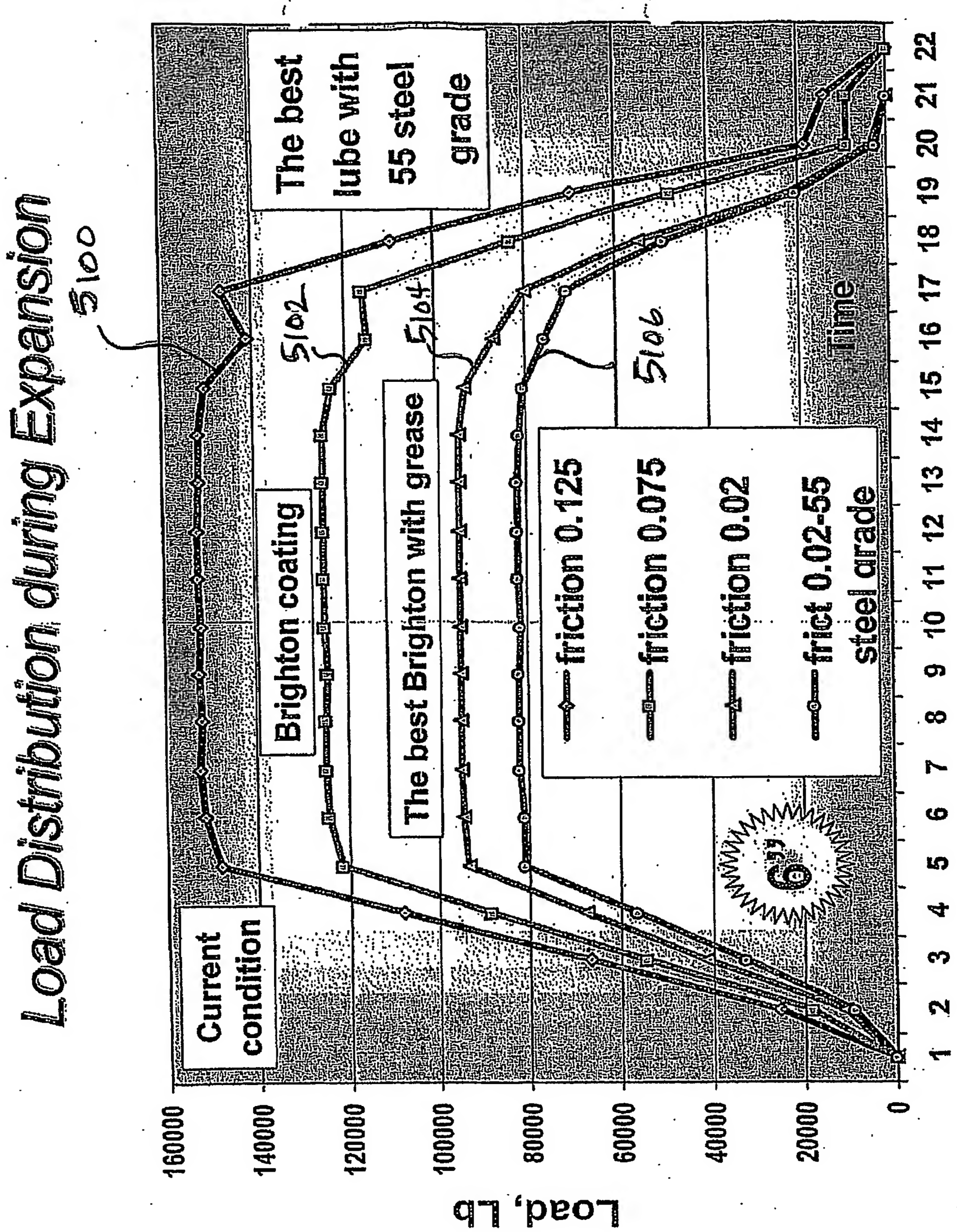

Load Distribution during Expansion
5100
5102
5104
5106
The best lube with 55 steel grade
Brighton coating
The best Brighton with grease
Current condition
friction 0.125
friction 0.075
friction 0.02
frict 0.02-55 steel grade
Load, Lb
160000
140000
120000
100000
80000
60000
40000
20000
0
Time
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

FIGURE 51

6"

Collapse Improvement Estimate

	Friction	Expansion force	Wall thickness	D/t after	Collapse Ksi
	0.125	145,900	0.305	24.8	2,379
	0.075	143,000	0.350	21.6	3,243
	0.02	149,900	0.450	16.8	5,837
	0.02	125,800	0.500	15.1	5,359
	0.02	126,800	0.500	15.1	8,443
Current 6" x .305 BSFL lube					
Brighton lube Application					
Best Brighton With grease					
Best lube with 55 ksi steel					
Best lube and steel with 55 Ksi yield before and 100 Ksi after pipe expansion					

5200 5202 5204 5206 5208

FIGURE 52

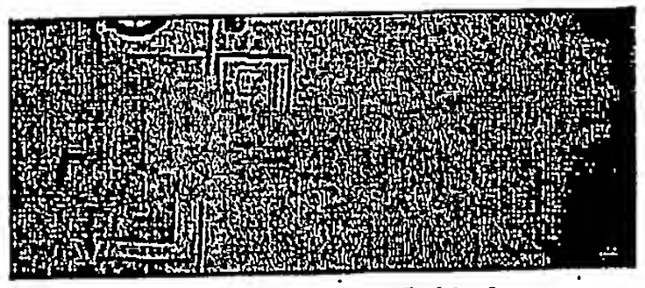
Pipe Compositions

Sample	C	Mn	P	S	Si	Cu	Ni	Cr	V	Mo	Nb	Ti
JFE-A*	.065	1.44	.01	.002	.24	.01	.01	.02	.04	.01	.03	.01
JFE-B*	.18	1.28	.017	.004	0.29	.01	.01	.03	.03	.03	.01	.01
X52x0.37	.08	.82	.006	.003	.30	.16	.05	.05	.06	.01	.03	.01
X52x0.52	.03	1.48	.014	.002	.16	.02	.01	.02	.06	.01	.03	.01

FIGURE 53

Tensile Characteristics before and after Mechanical Expansion

5400



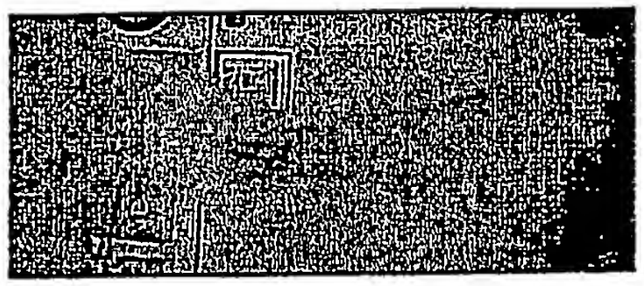
NT 55HE Pipe, 16 %

	5402 Yield ksi	5404 Yield ratio	5406 Elongation %	5408 Width reduction %	5410 Wall thickness reduction, %	5412 Anisotropy %
Before	61.5	.62	17	26	47	.46
After	74.7	.77	14	28	54	.44
Change %	21.4	24	- 18	7.7	14.5	- 4.4

FIGURE 54

5500

Tensile Characteristics before and after Mechanical Expansion



JFE "History" Pipe, 15.6 %

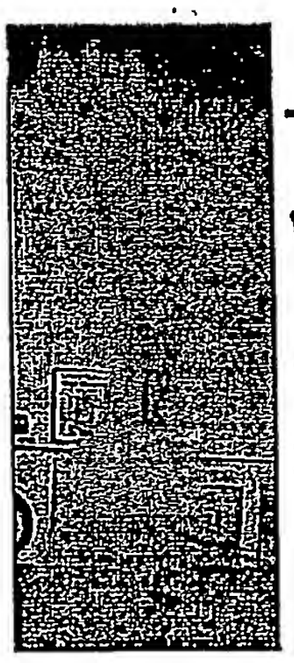
	5502 Yield ksi	5504 Yield ratio	5506 Elongation %	5508 Width reduction %	5510 Wall thickness reduction, %	5512 Anisotropy %
Before	61.9	.6	12	18	15	1.24
After	105	.75	4	13	14	.94
Change %	-70	-25	- 67	27.8	6.7	75

FIGURE 55

Tensile Characteristics before and after Mechanical Expansion

VM 50, 24 %

	Yield ksi	Yield ratio	Elongation %	Width reduction %	Wall thickness reduction, %	Anisotropy %
Before	64	.78	20	47	59	.72
After	71	.80	14	41	58	.60
Change %	10.2	2.6	-30	-13	-1.7	-16.7



5602 5604 5606 5608 5610 5612

5600

FIGURE 56

5700

Tensile Characteristics before and after Mechanical Expansion

JFE option A

	Yield ksi 5702	Yield ratio 5704	Elongation% 5706	Width reduction 5708 %	Wall thickness reduction, % 5710	Anisotropy % 5712
Before	46.9	.69	53	-52	55	.93
16 % Expan.	65.9	.83	17	42	51	.78
24 % Expan	68.5	.83	5	44	54	.76
Change %	46	-20	91	15	2	18

FIGURE 57

WO 2005/017303
PCT/US2004/026345
96/99

Tensile Characteristics before and after Mechanical Expansion

JFE, option A (#1) 16 %

	Yield ksi	Elongation %	Width reduction %	Wall thickness reduction, %	Anisotropy %
Before	47.7	23	46	53	0.81
After	65.9	17	42	51	0.78
Change %	38	11	9	4	4

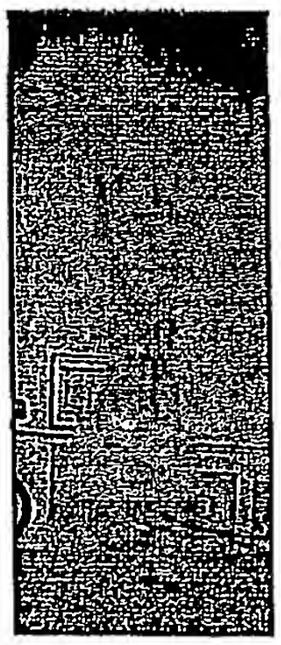
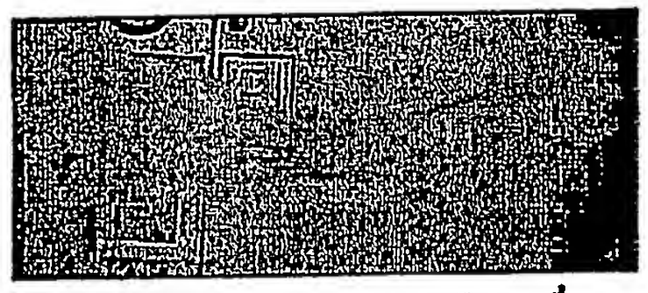


FIGURE 58

Tensile Characteristics before and after Mechanical Expansion

5900



JFE, option A (#1) 24 %

	5902 Yield ksi	5904 Yield ratio	5906 Elongation %	5908 Width reduction %	5910 Wall thickness reduction, %	5912 Anisotropy %
Before	47.7	.69	23	46	53	0.81
After	62.3	.71	12	40	52	.71
Change %	31	14	48	13	2	12

FIGURE 59

Tensile Characteristics before and after Mechanical Expansion
JFE option B

	Yield ksi (0.2% offset)	Yield ratio (yield/ultimate)	Elongation % (2" gage)	Width reduction % (gage)	Wall thickness reduction, % (gage)	Anisotropy % (gage)
Before Expan.	57.8	.71	44	43	46	.93
16% Expan.	74.4	.84	16	38	42	.87
24% Expan	79.8	.86	20	36	42	.81
Changes, %	38	21	55	16	9	13

6000

FIGURE 60

Tensile Characteristics before and after Mechanical Expansion

JFE, option B (#2) 16 %

	Yield ksi	Elongation %	Width reduction %	Wall thickness reduction %	Anisotropy %
Before	56.6	20	39	45	83
After	74.8	14	33	41	75
Change %	33	30	15	9	10

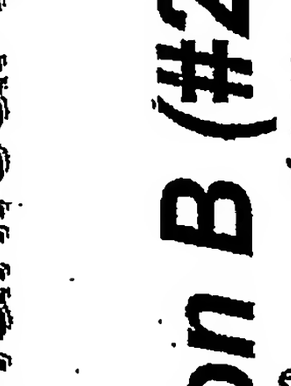


FIGURE 61

Tensile Characteristics before and after Mechanical Expansion

JFE, option B (#2) 24 %

6210 6212

Yield ratio %	Elongation %	Width reduction %	Wall thickness reduction, %	Anisotropy %
6206	6208			
.66	20	.39	.45	.83
.84	12	31	38	.79
.27	40	21	16	5

	Yield ksi
Before	56.4
After	79.6
Change %	41

6200

FIGURE 62

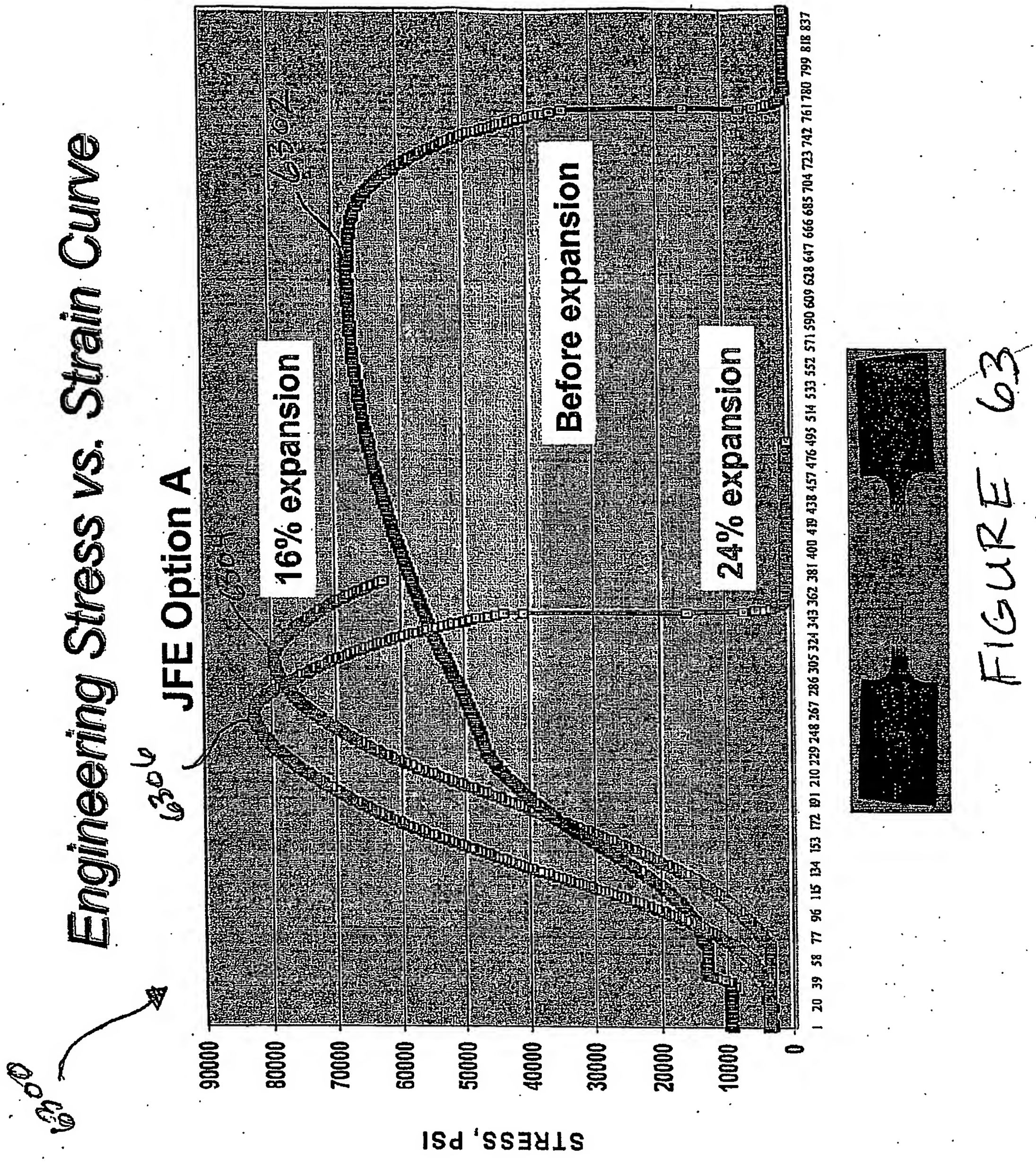

Engineering Stress vs. Strain Curve
630b
JFE Option A
630a
16% expansion
Before expansion
24% expansion
STRESS, PSI
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1 20 39 58 77 96 115 134 153 172 191 210 229 248 267 286 305 324 343 362 381 400 419 438 457 476 495 514 533 552 571 590 609 628 647 666 685 704 723 742 761 780 799 818 837

FIGURE 63

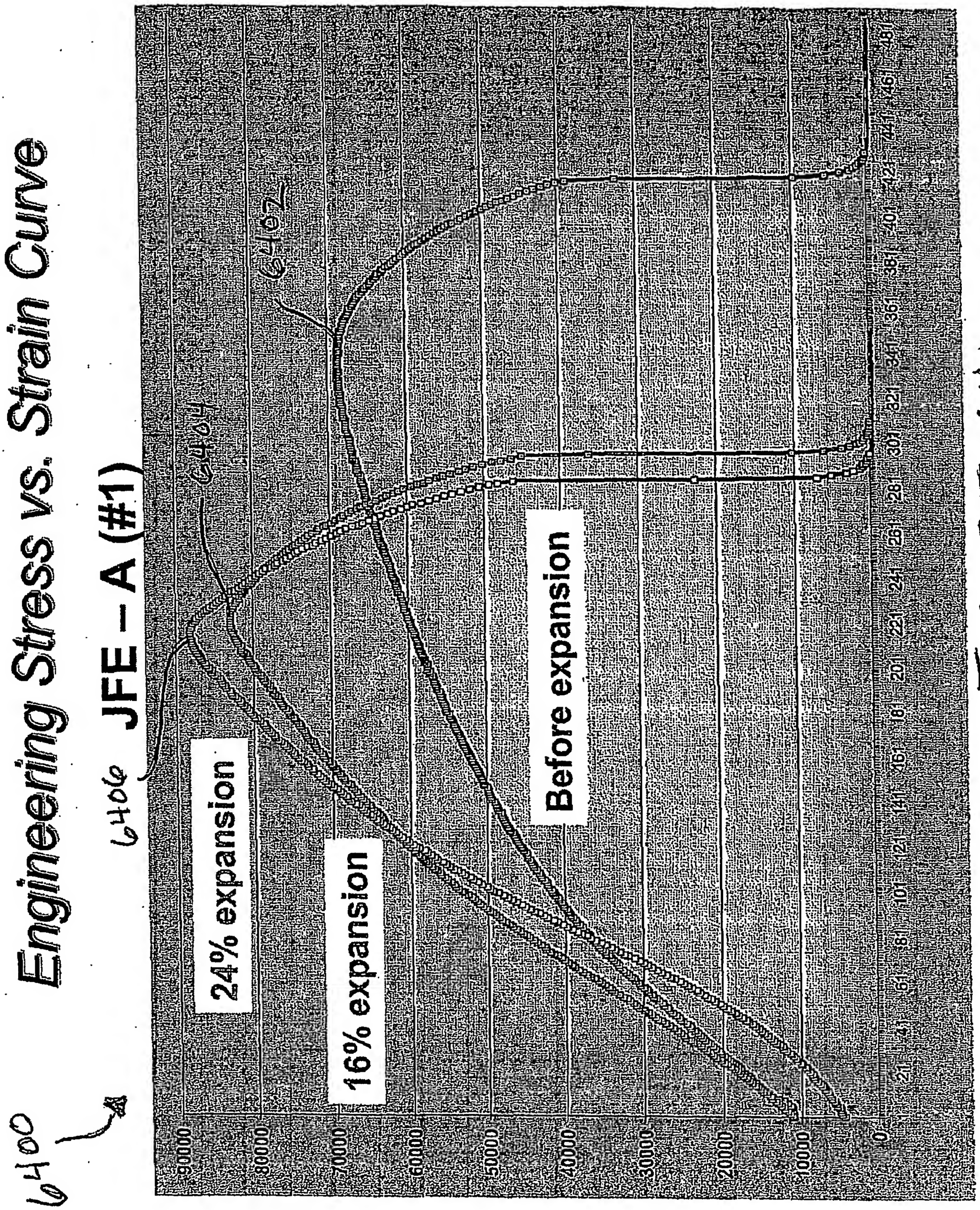

Engineering Stress vs. Strain Curve
JFE – A (#1)
406
402
404
Fig 7
Before expansion
16% expansion
24% expansion
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1
21
41
61
81
101
121
141
161
181
201
221
241
261
281
301
321
341
361
381
401
421
441
461
481

FIGURE 64

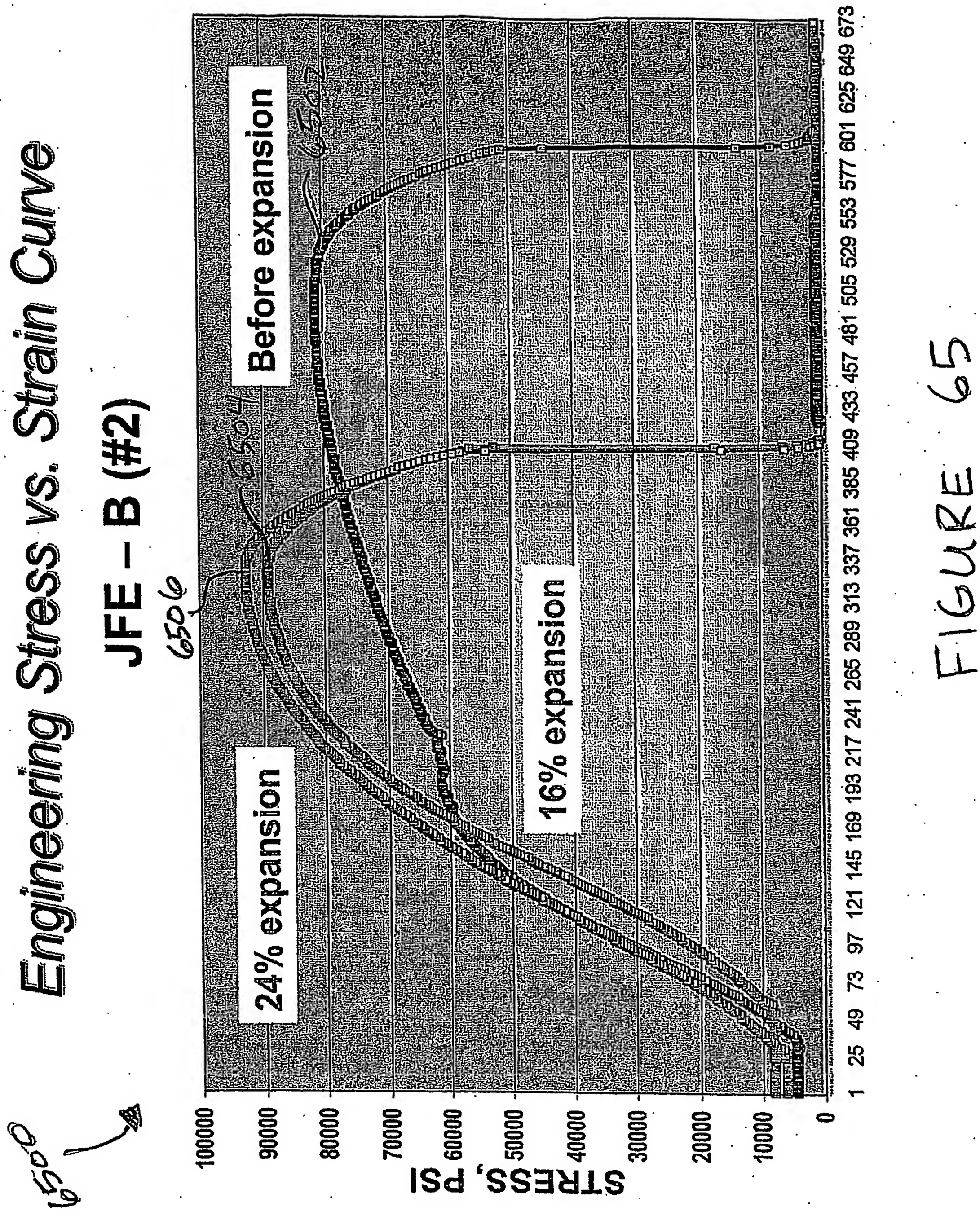

Engineering Stress vs. Strain Curve
JFE – B (#2)
650
1500
Before expansion
24% expansion
16% expansion
STRESS, PSI
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1 25 49 73 97 121 145 169 193 217 241 265 289 313 337 361 385 409 433 457 481 505 529 553 577 601 625 649 673

FIGURE 65

6600

Engineering Stress vs. Strain Curve
Inconel C 276 material

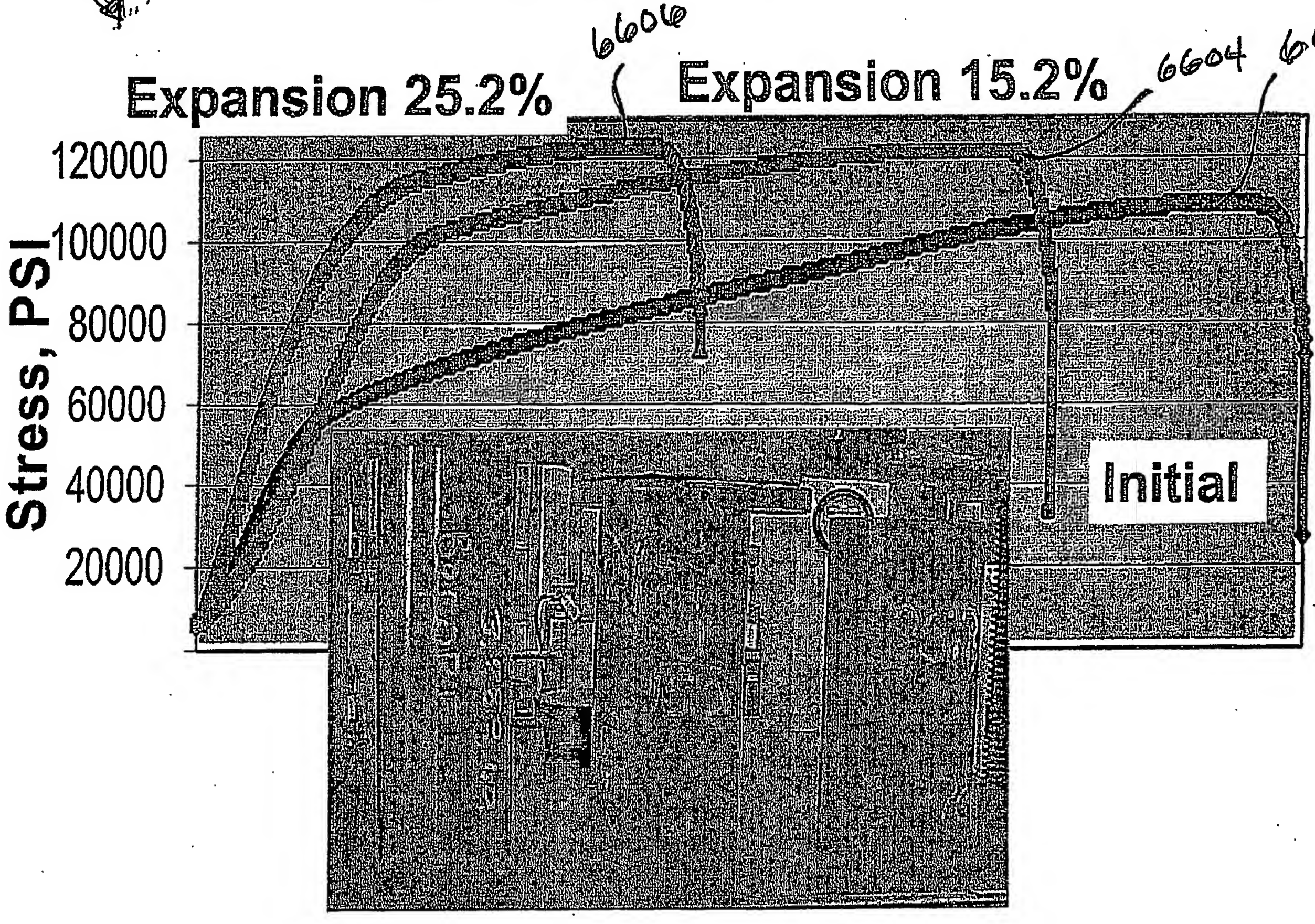


FIGURE 66

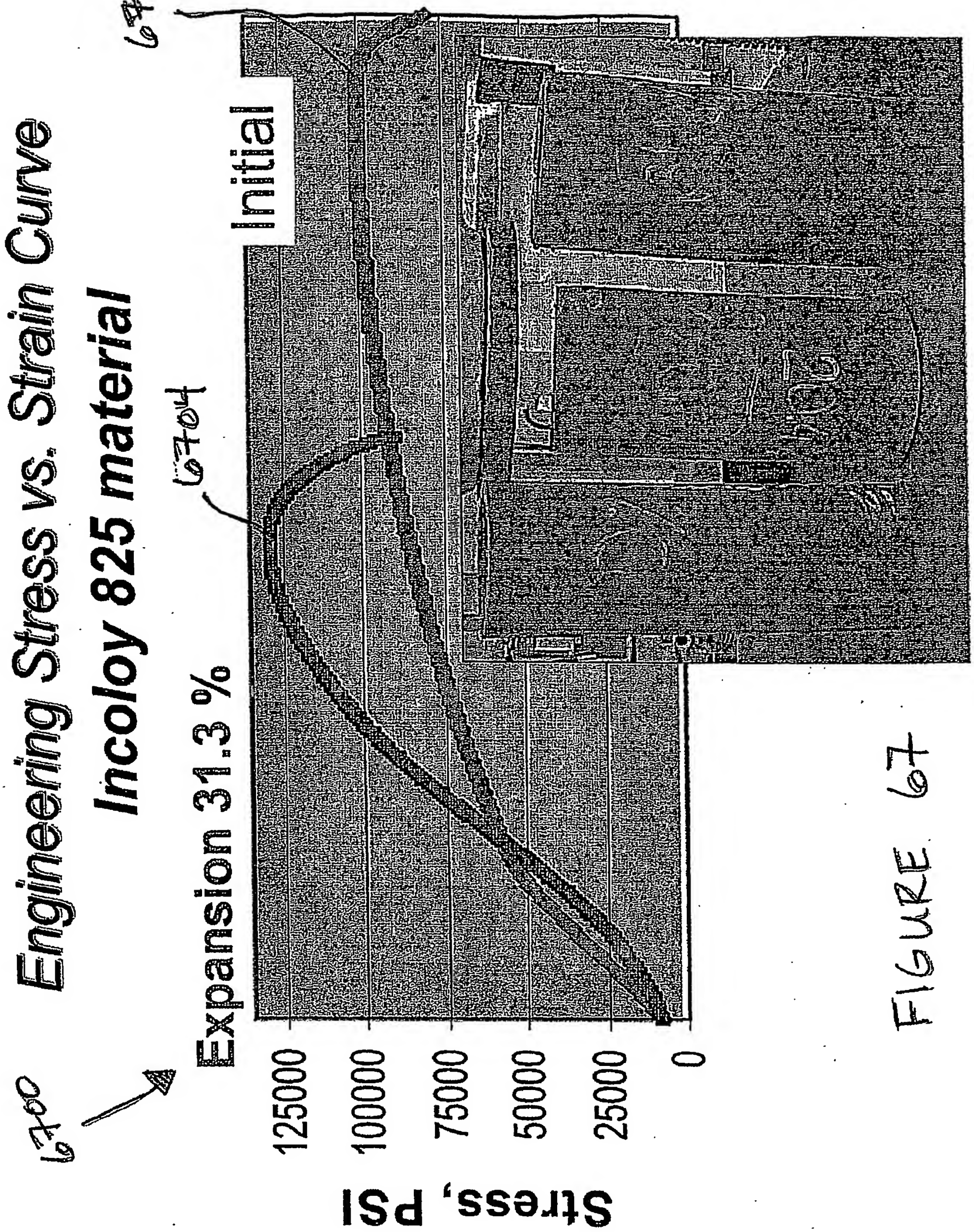

Engineering Stress vs. Strain Curve
Incoloy 825 material
Initial
Expansion 31.3 %
Stress, PSI
125000
100000
75000
50000
25000
0

FIGURE 67

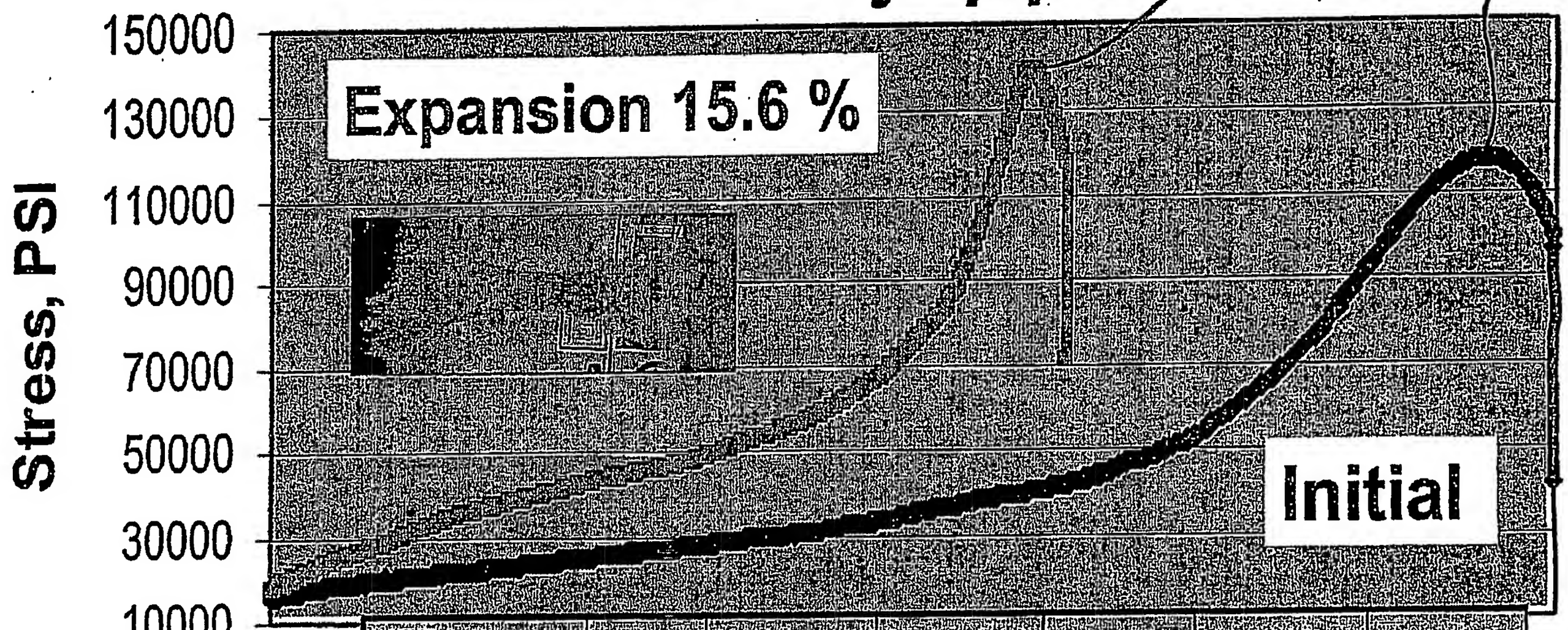
6800

Engineering Stress vs. Strain Curve

"History" pipe

6804

6802



material	Yield ksi	Yield / Tensile ratio	Elongation Longitudinal %	Width Reduction %	Wall thickness Reduction, %	Anisotropy
target	76.8	0.82	16	32	45	0.65
History	50.7	0.44	12	18	15	1.24

FIGURE 68a

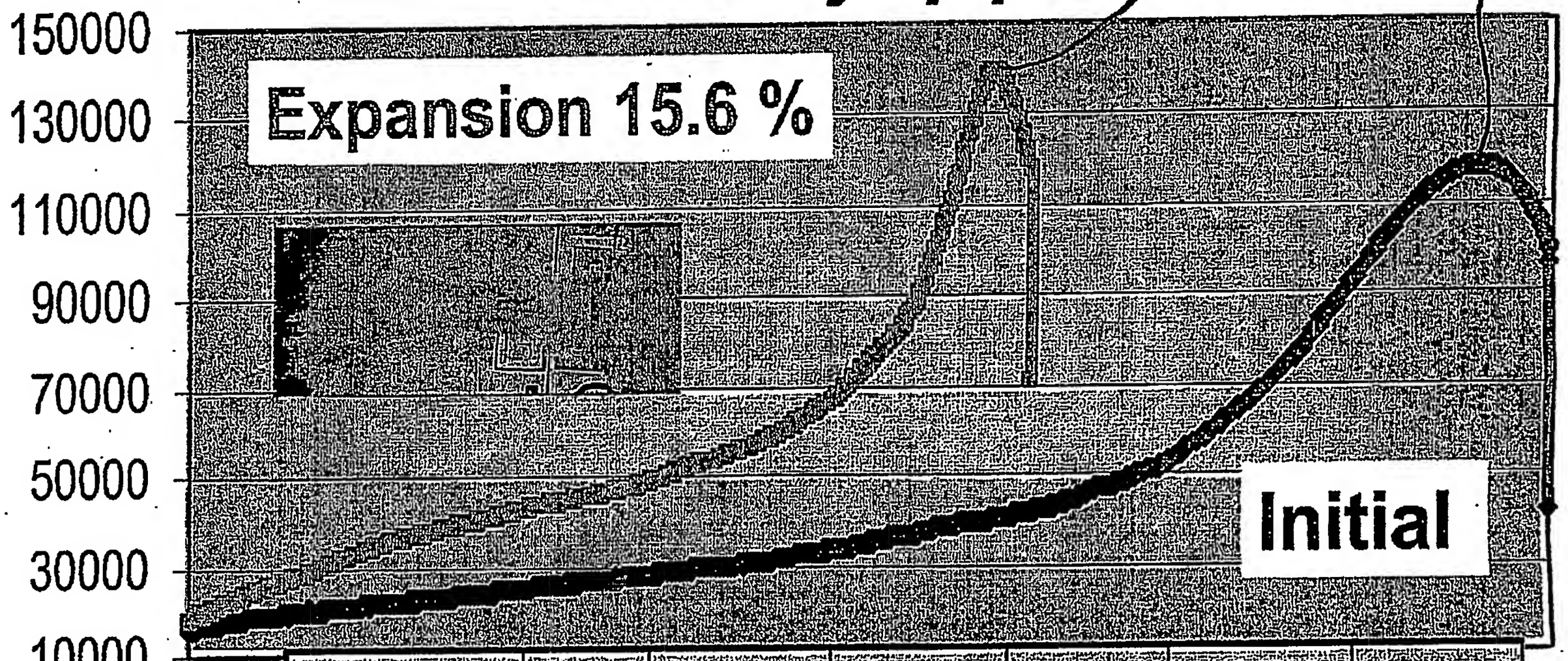
6800

Engineering Stress vs. Strain Curve

"History" pipe

6804

6802



6806

material	Yield ksi	Yield / Tensile ratio	Elongation Longitudinal %	Width Reduction, %	Wall thickness Reduction, %	Anisotropy
target	76.8	0.82	16	32	45	0.65
History	50.7	0.44	12	18	15	1.24

FIGURE 68b

6900

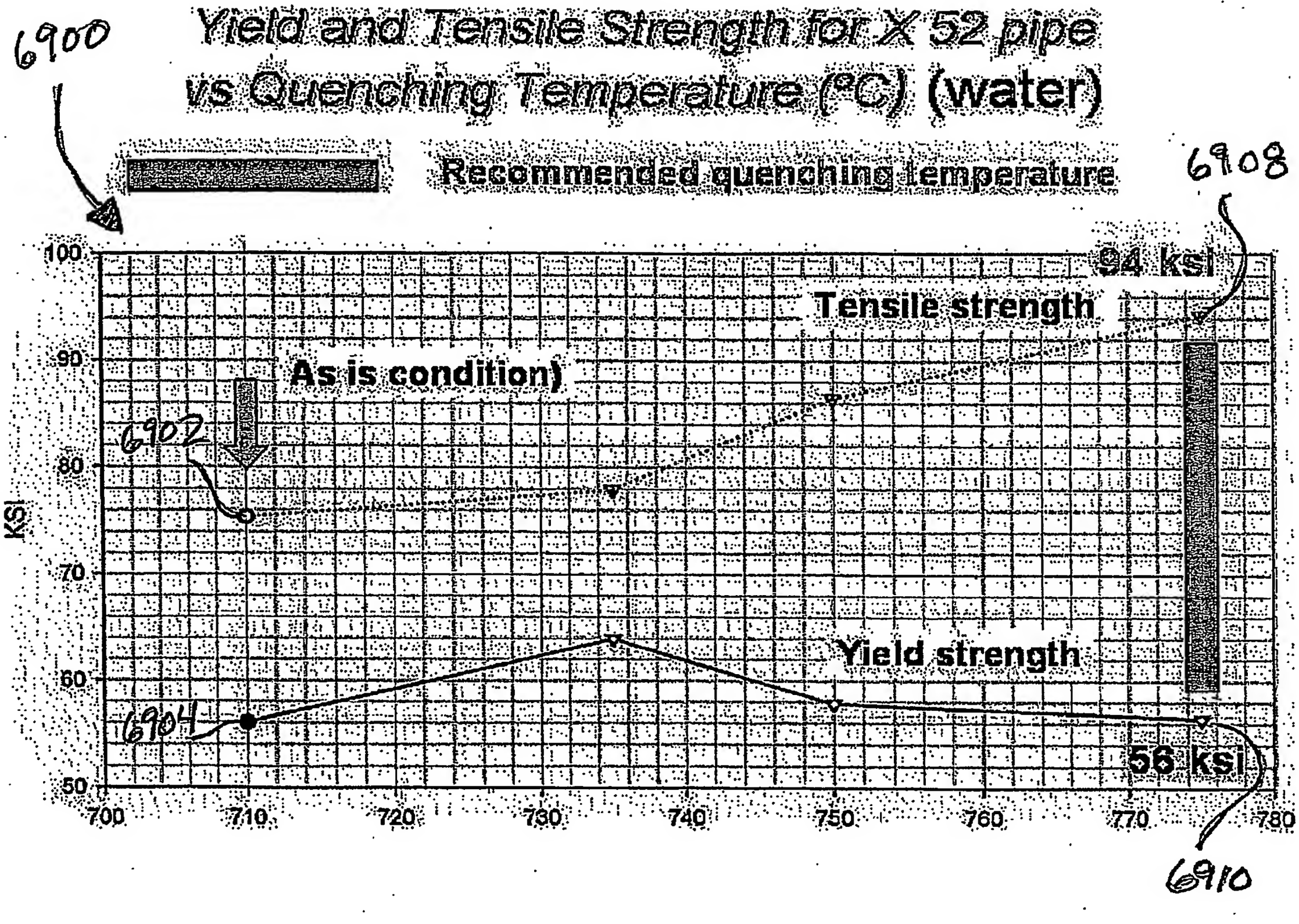


FIGURE 69

7000

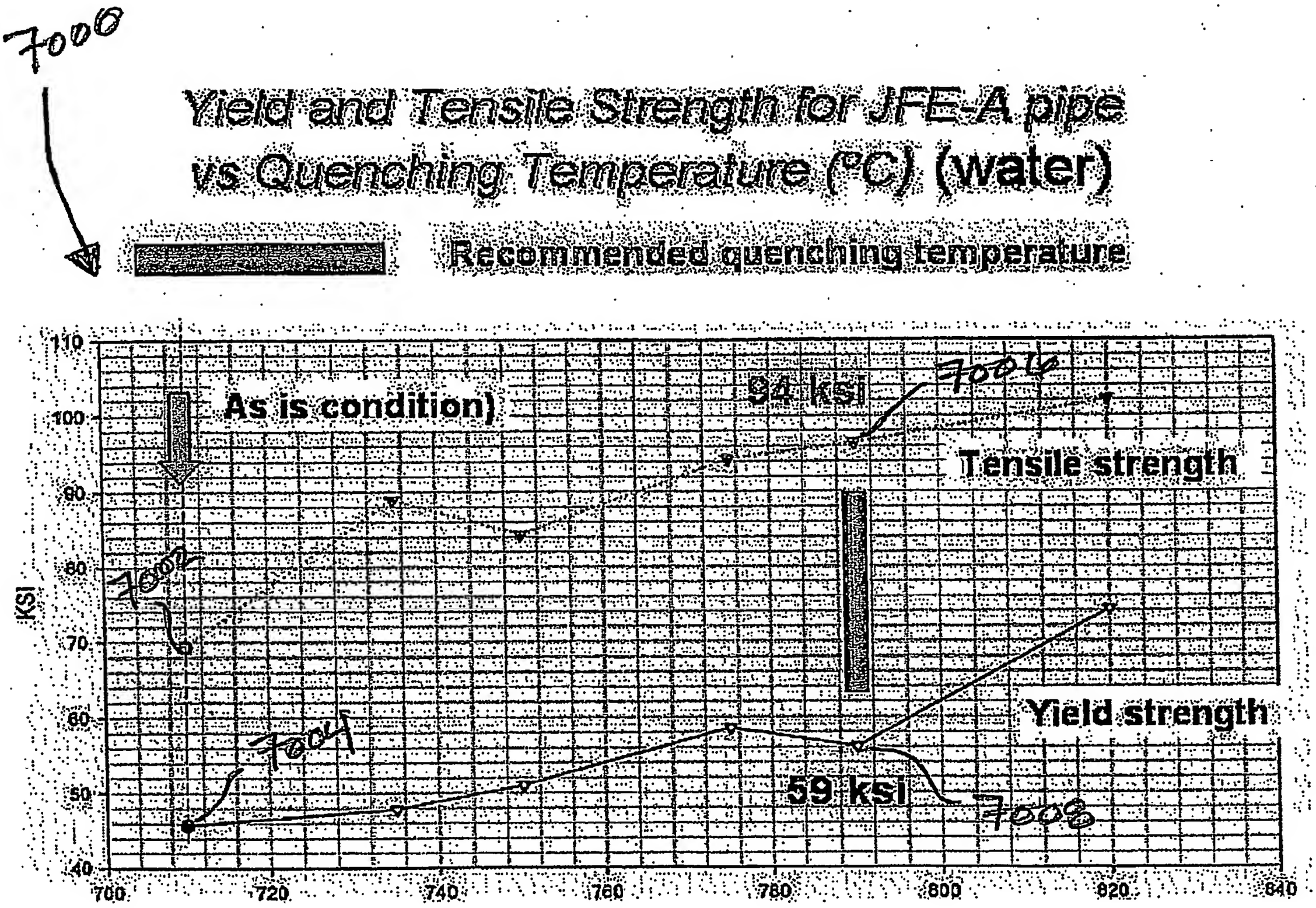


FIGURE 70

7100

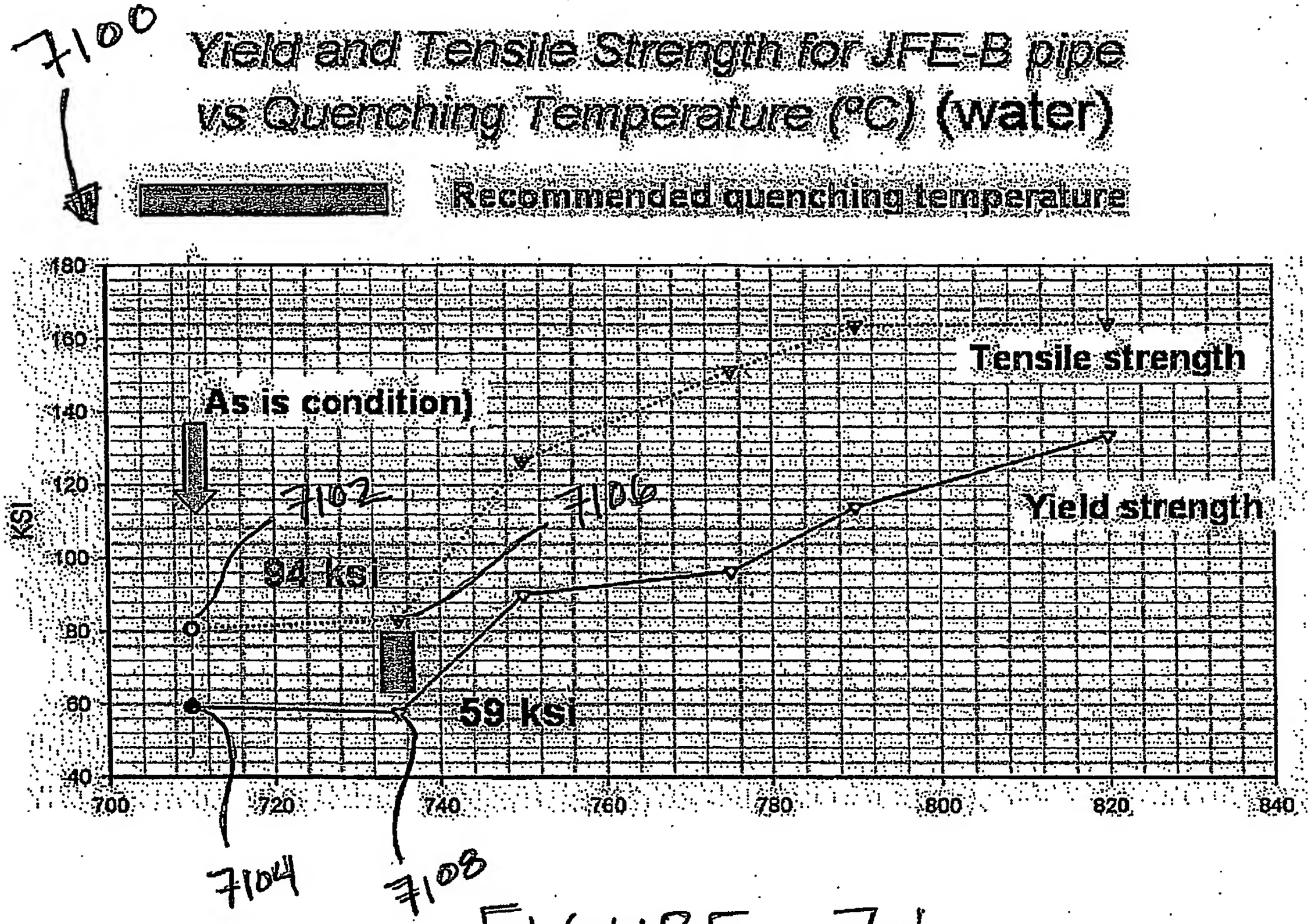


FIGURE 71

7200

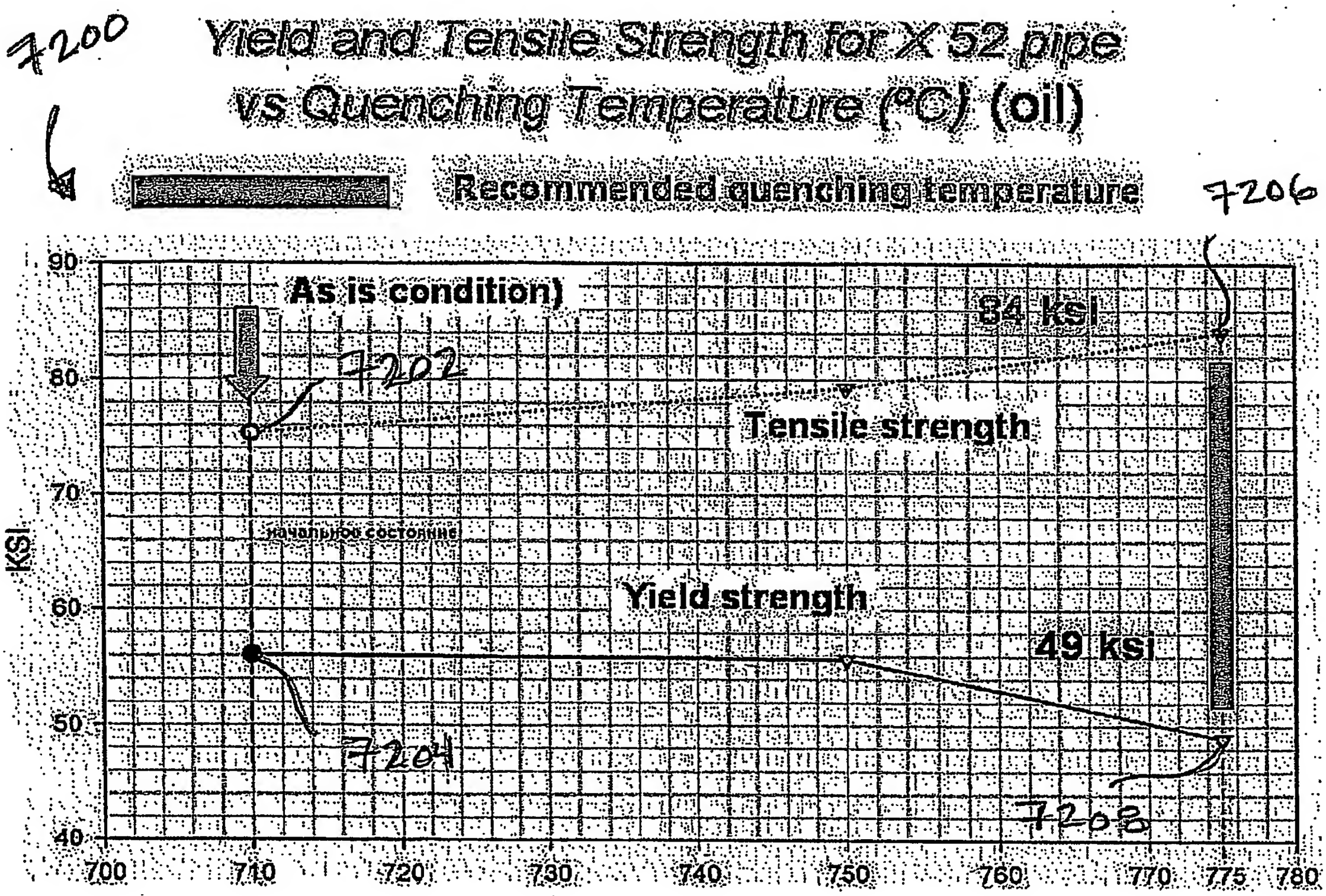


FIGURE 72

7300

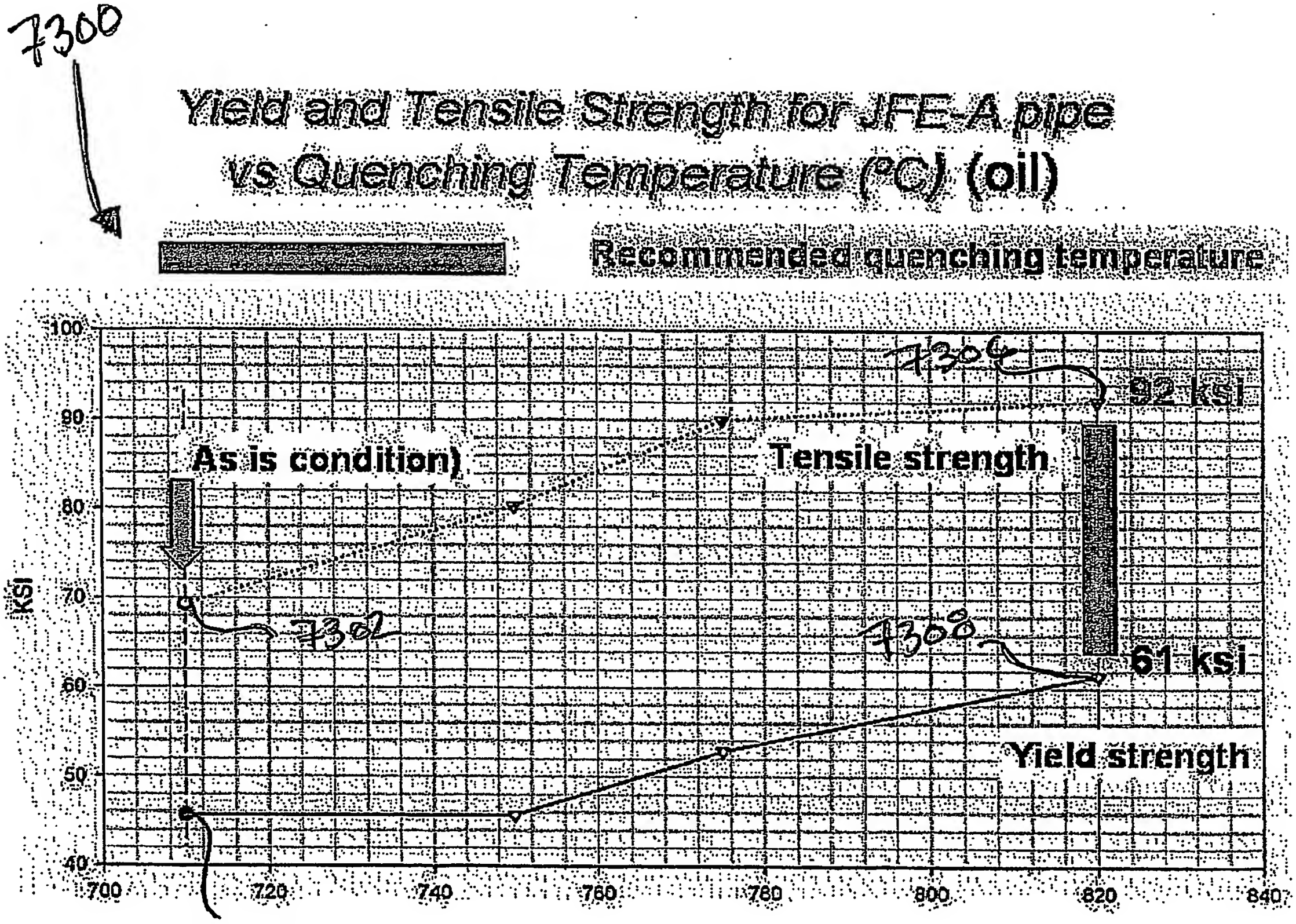


FIGURE 73

7460

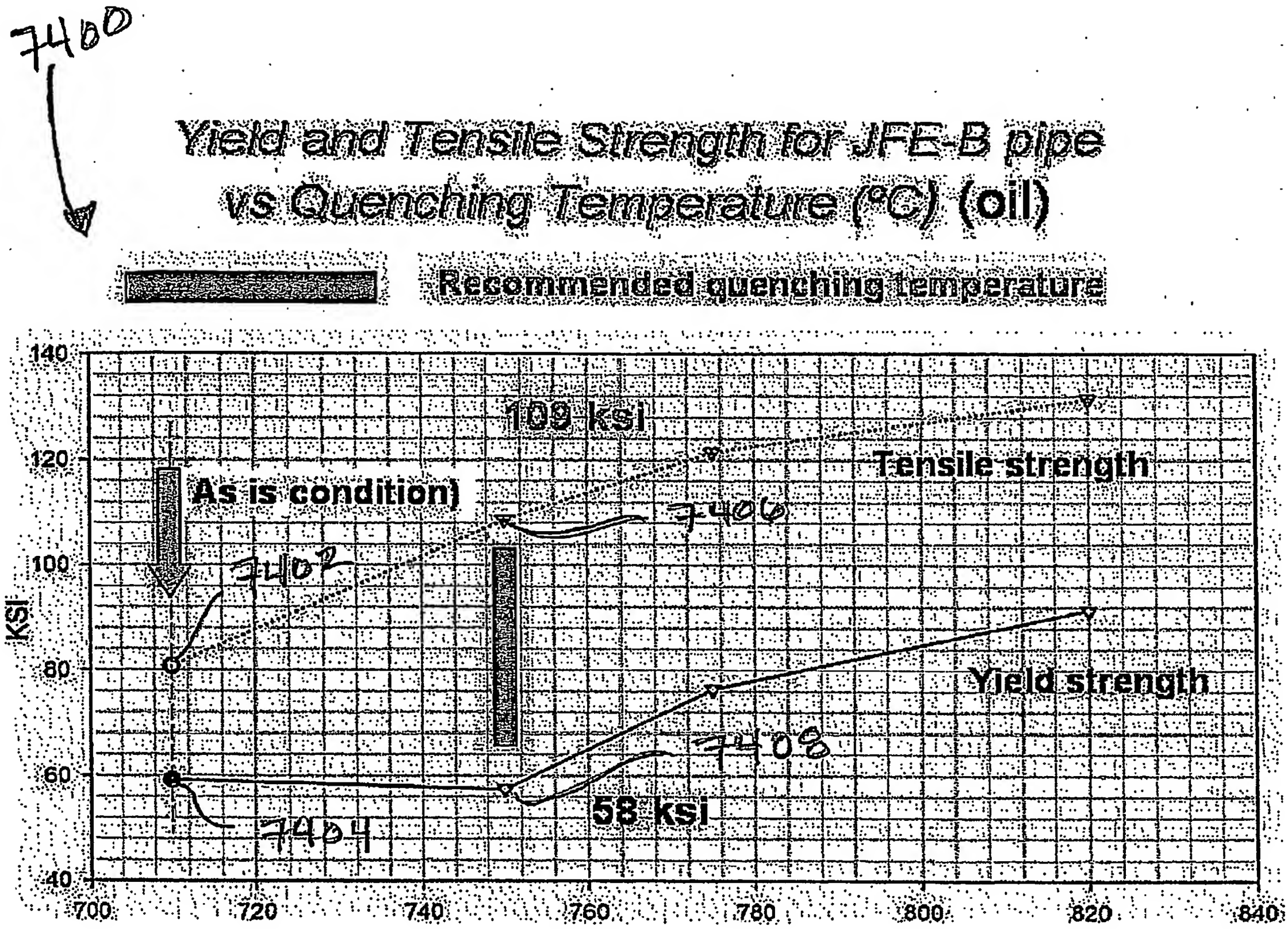
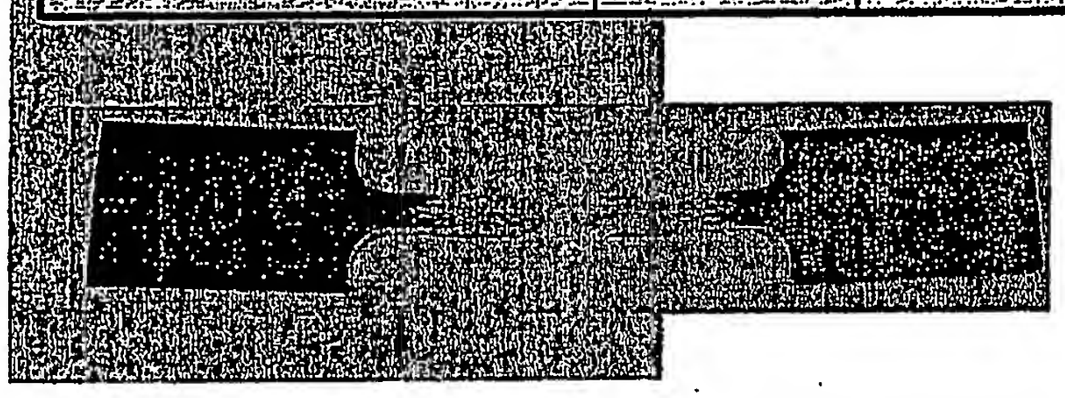


FIGURE 74

Stress-Strain Property of the Target vs. Quench & Temper N Steel Pipes*

material	Yield, ksi 7506	Yield / Tensile ratio 7508	Elongation Longitudinal % 7510	Width Reduction,% 7512	Wall thickness Reduction, % 7514	Anisotropy 7516
target 7500	80.18	0.857	14.75 *	38.3	43.0	0.868
7502 Quench & temper pipe-1	81.25	0.829	14.88 *	37.8	43.25	0.830
7504 Quench & temper pipe-2	78.77	0.822	15.90 *	44.0	43.33	1.03



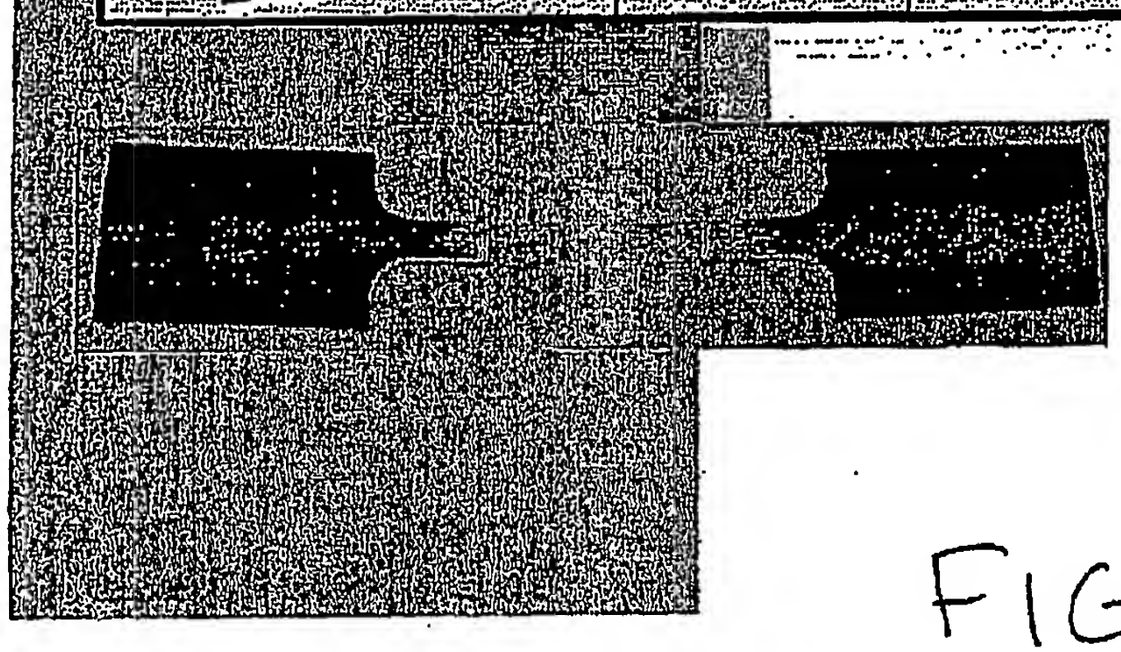
*An average from 4 measurements

* 5 " base line

FIGURE 75

Stress-Strain Property of the Target vs. Quench & Temper Nippon Steel Pipes*

material 7504	Yield ksi 7506	Yield / Tensile ratio 7508	Elongation Longitudinal % 7510	Width Reduction, % 7512	Wall thickness Reduction, % 7514	Anisotropy
target 7500	80.18	0.857	14.75*	38.3	43.0	0.868
Quench & temper pipe 7502	80.19	0.826	15.25*	40.4	43.3	0.915



*An average from 4 (target) and 8 (quench & temper measurements

*5 " base line

FIGURE 76

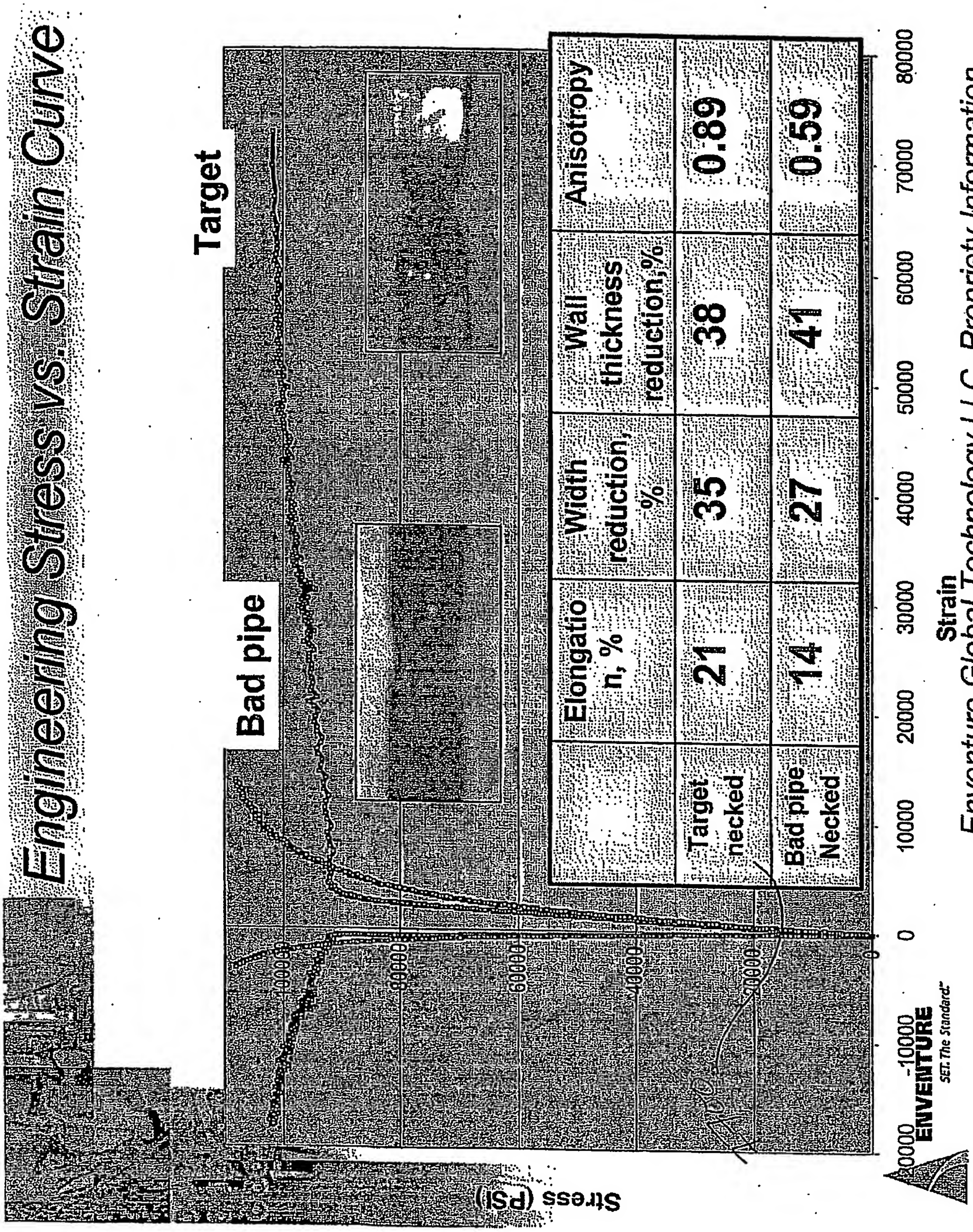

Engineering Stress vs Strain Curve
Target
Bad pipe
Wall thickness reduction, % Anisotropy
38 0.89
41 0.59
Elongation, n, % Width reduction, %
Target necked 21 35
Bad pipe Necked 14 27
Stress (PSI)
Strain
10000 20000 30000 40000 50000 60000 70000 80000
-10000 0
Enventure Global Technology LLC. Propriety Information
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FIGURE 47

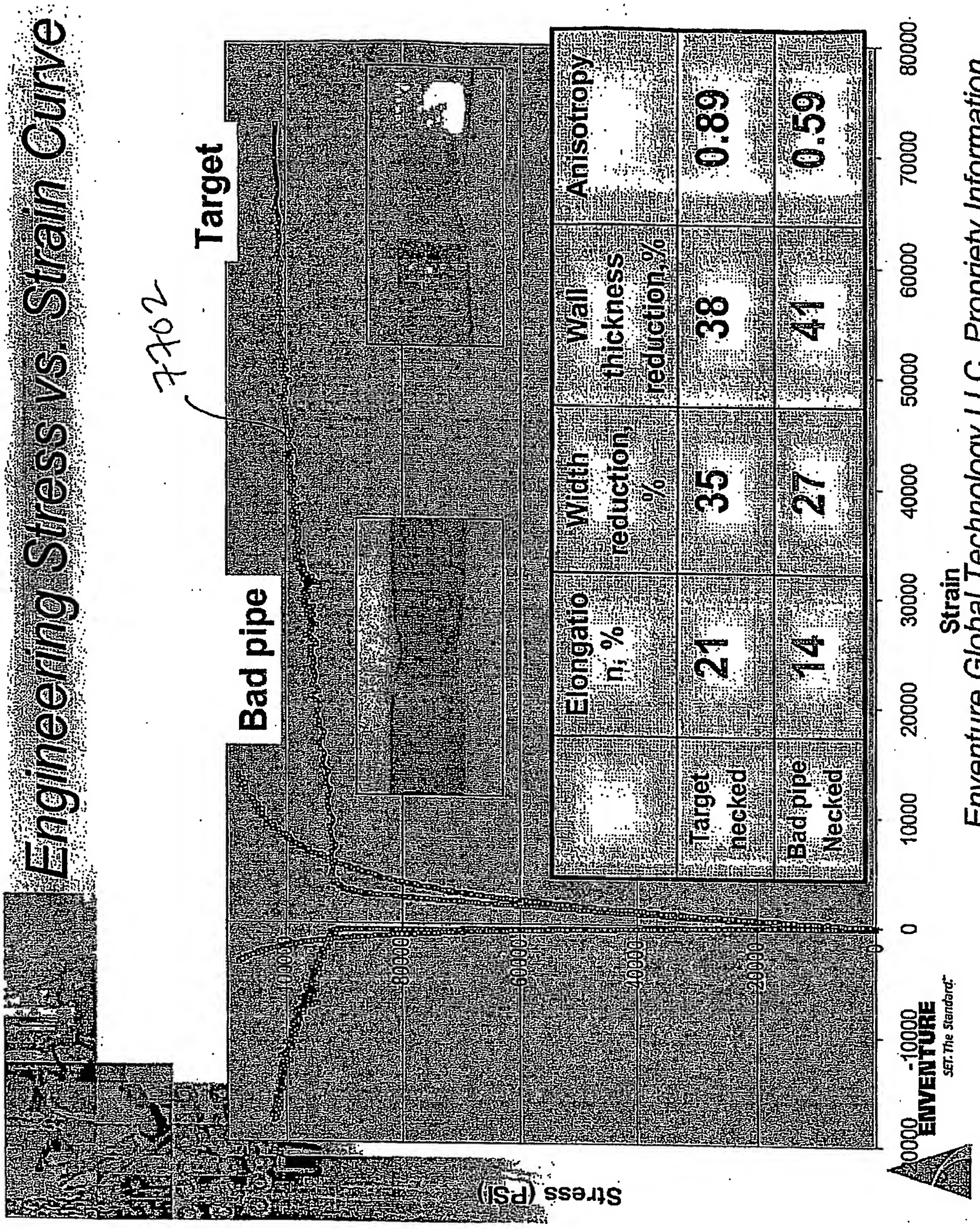
Engineering Stress V/s. Strain Curve
Target
Bad pipe
Elongation %
Width reduction, %
Wall thickness reduction, %
Anisotropy
Target 21 35 38 0.89
Necked
Bad pipe 14 27 41 0.56
Necked
Stress (PSI)
Strain
Enventure Global Technology LLC. Proprietary Information
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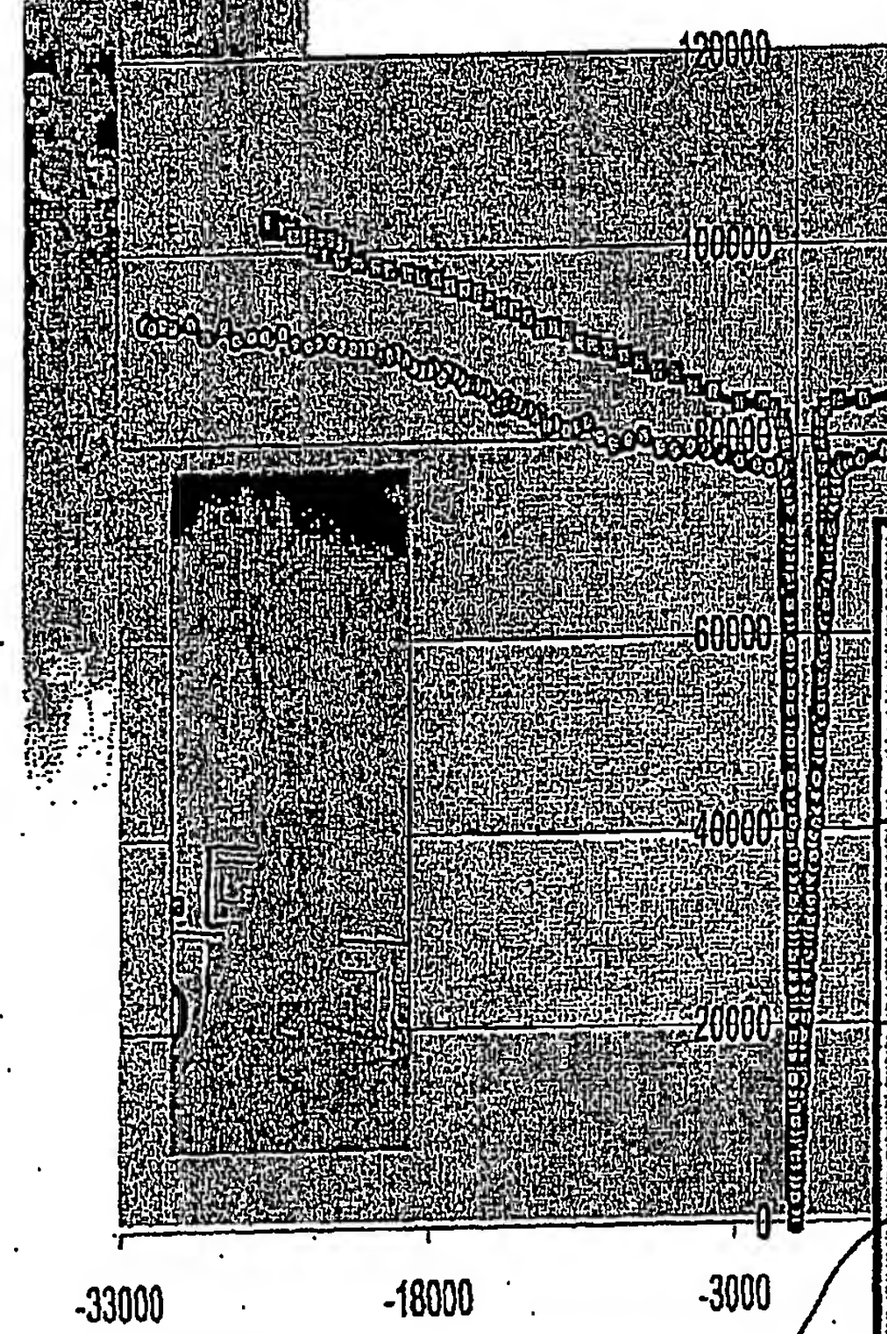
FIGURE 7b

Engineering Stress vs. Strain Curve



material	Yield ksi	Yield / Tensile ratio	Elongation Longitudinal %	Width Reduction,%	Wall thickness Reduction, %	Anisotropy
target	76.8	0.82	16	32	45	0.65
Quench & temper	84.6	0.85	21	39	43	0.88

FIGURE 78a

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Engineering Stress vs. Strain Curve

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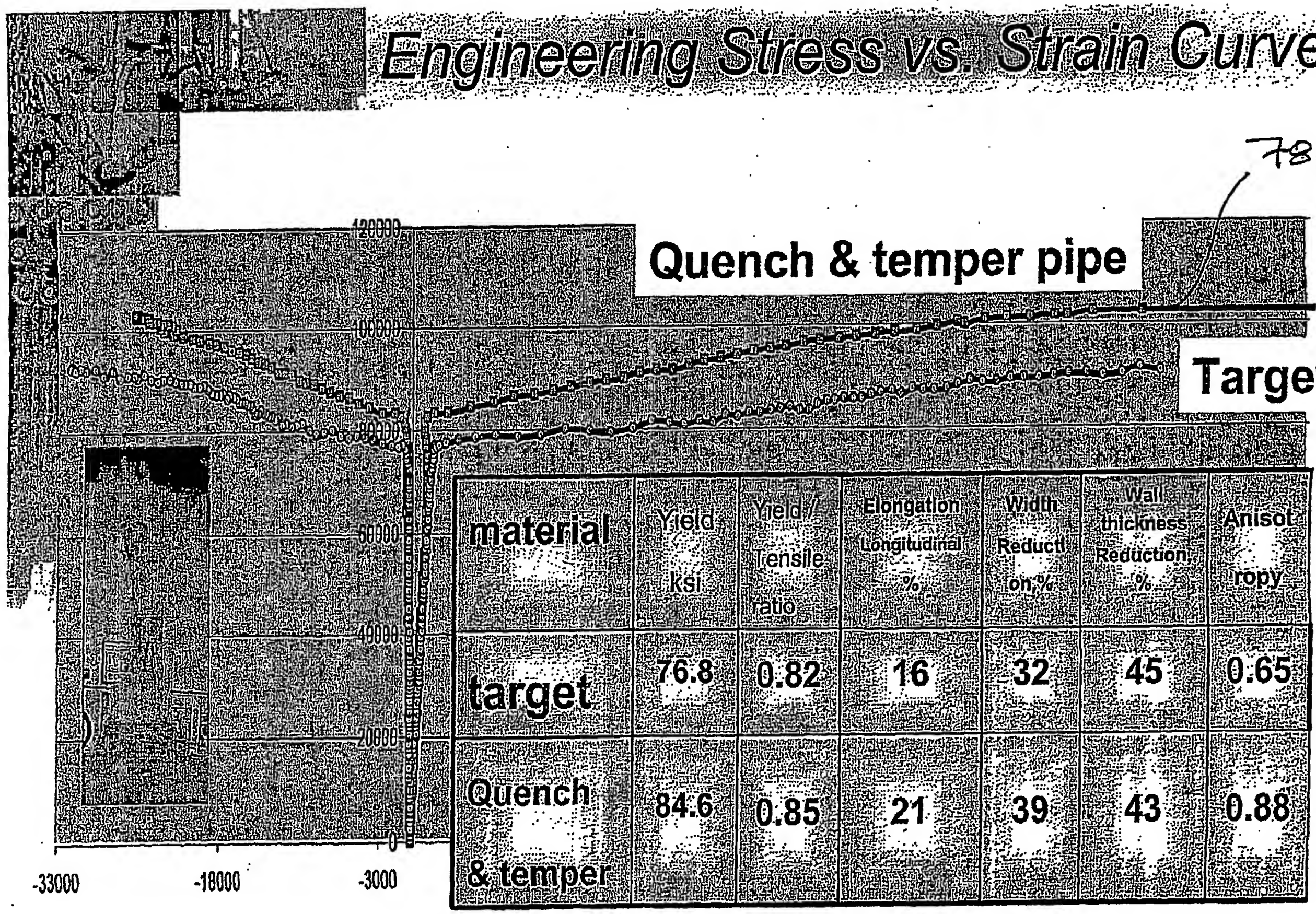

material	Yield ksi	Yield / Tensile ratio	Elongation Longitudinal %	Width Reduction %	Wall thickness Reduction %	Anisotropy
target	76.8	0.82	16	32	45	0.65
Quench & temper	84.6	0.85	21	39	43	0.88

FIGURE 78b

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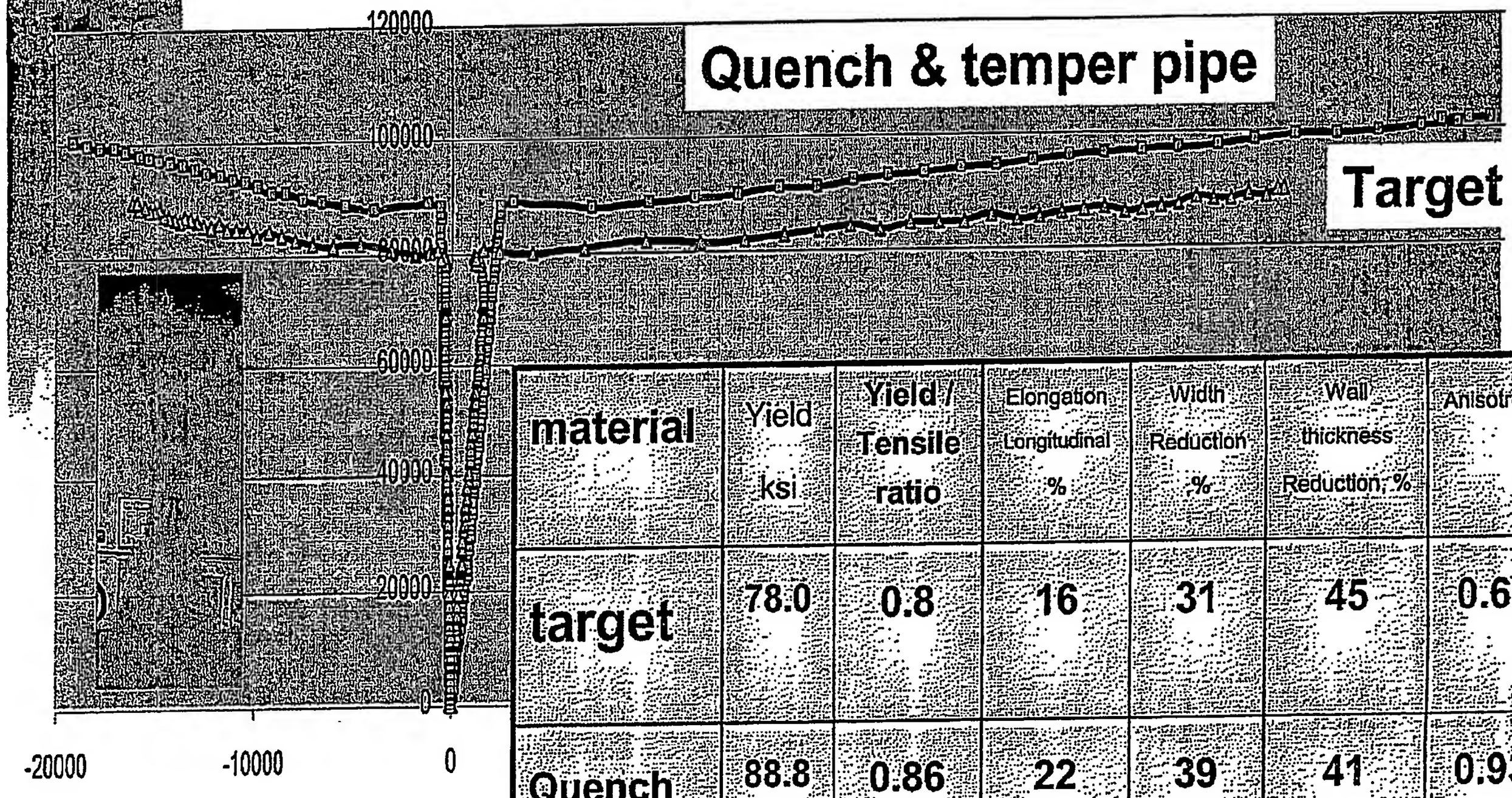
Engineering Stress vs. Strain Curve



material	Yield ksi	Yield / Tensile ratio	Elongation Longitudinal %	Width Reduction %	Wall thickness Reduction, %	Anisotropy
target	78.0	0.8	16	31	45	0.63
Quench & temper	88.8	0.86	22	39	41	0.93

7900

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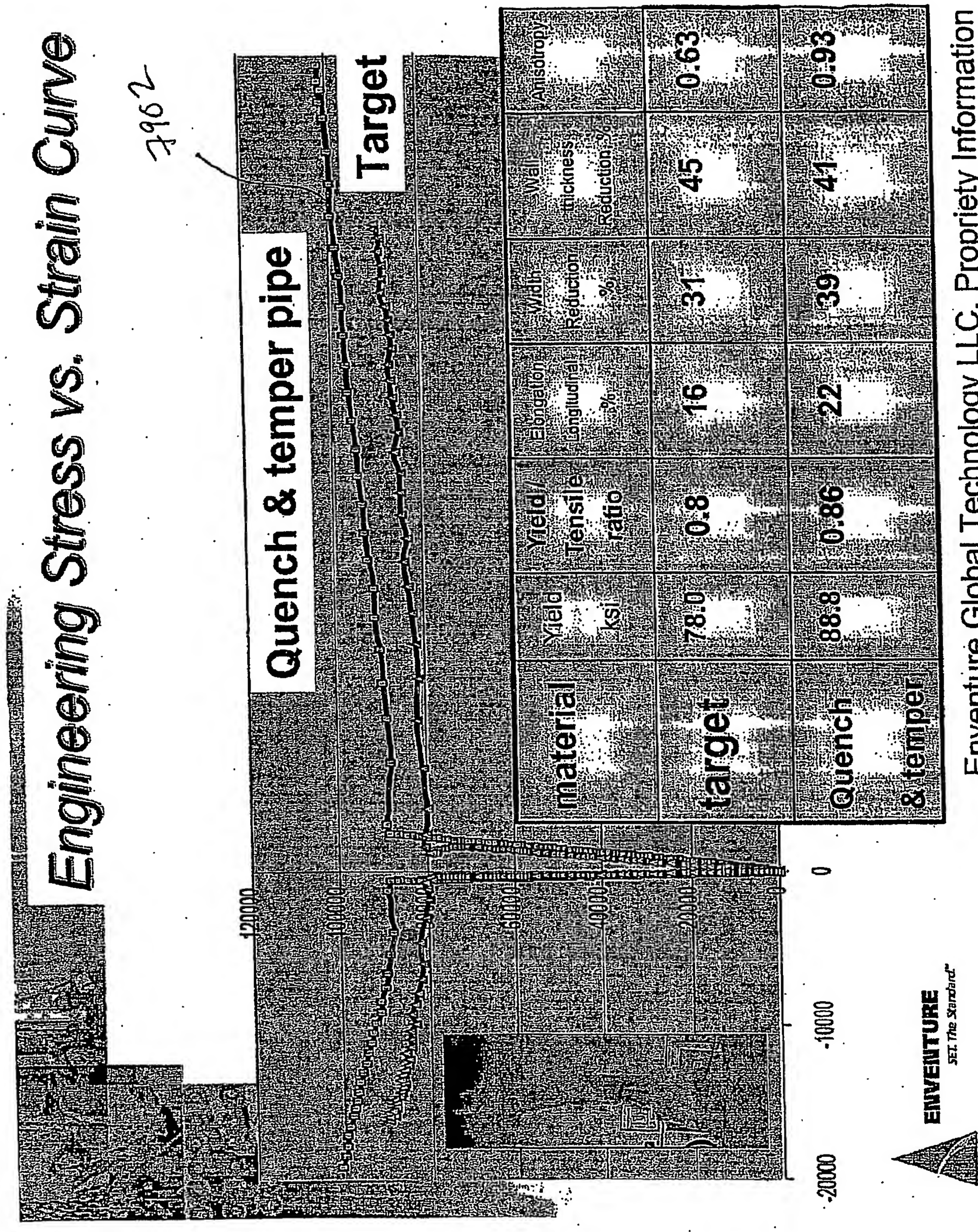
FIGURE 79a


Engineering Stress vs. Strain Curve
Quench & temper pipe
Target
material
Yield
ksi
Yield / Tensile ratio
Elongation
Longitudinal %
Width Reduction %
Wall thickness Reduction %
Anisotropy
target
78.0
0.8
16
31
45
0.63
39
41
0.93
Quench & temper
88.8
0.86
22
120000
100000
80000
60000
40000
20000
0
-10000
-20000
Enventure Global Technology LLC. Propriety Information
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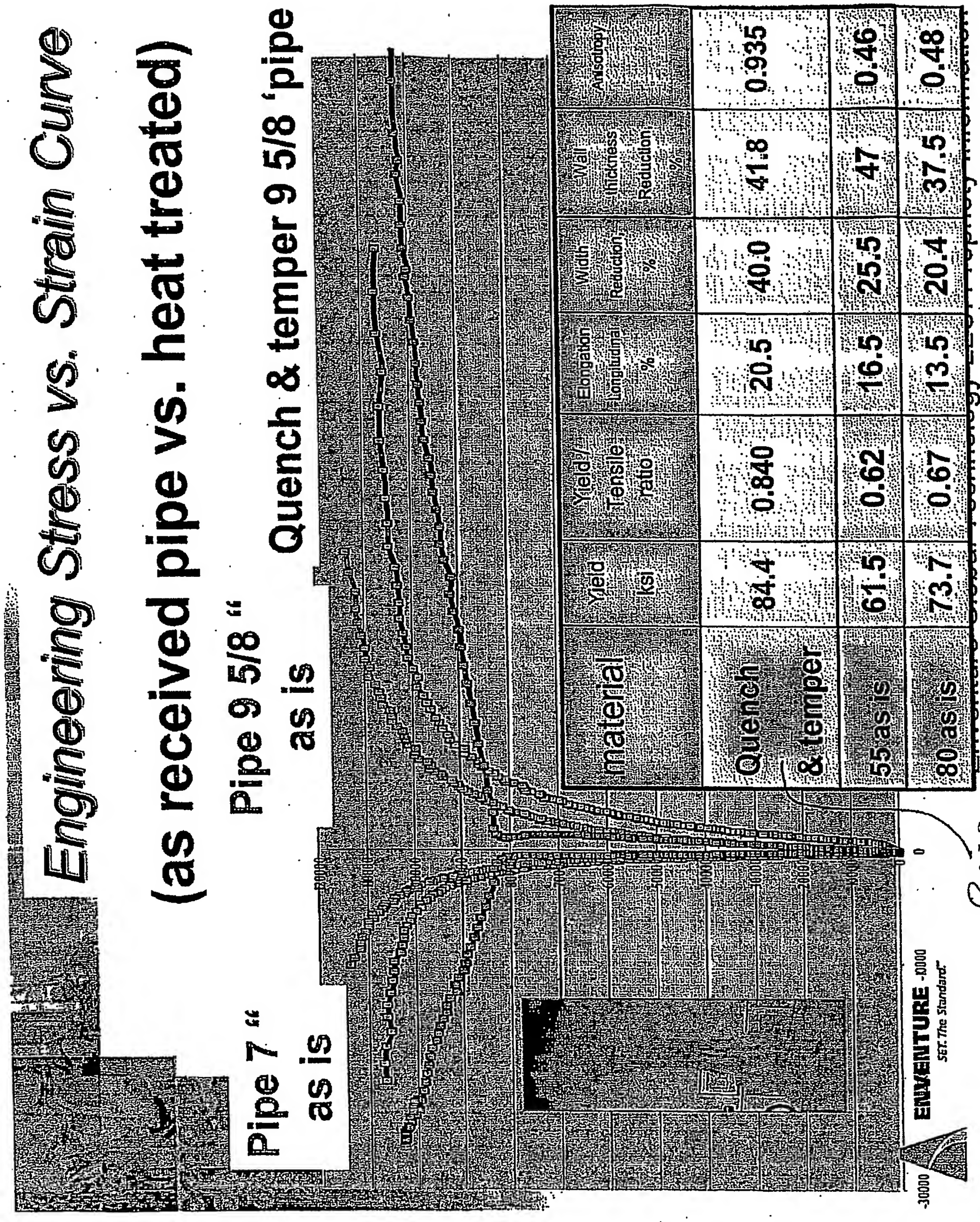
SET The Standard

FIGURE 7A


Engineering Stress vs. Strain Curve
(as received pipe vs. heat treated)
Pipe 9 5/8 " as is
Quench & temper 9 5/8 'pipe
Pipe 7 " as is
material
Yield ksi
Tensile ksi
Yield/ Tensile ratio
Elongation Longitudinal %
Reduction, Width %
Wall Thickness Reduction, %
Anisotropy
Quench & temper
84.4
0.840
40.0
41.8
0.935
55 asis
61.5
0.62
25.5
47
0.46
80 asis
73.7
0.67
20.4
37.5
0.48
ENVENTURE -0000
SET: The Standard"
-30000
0
1000
FIGURE 80a

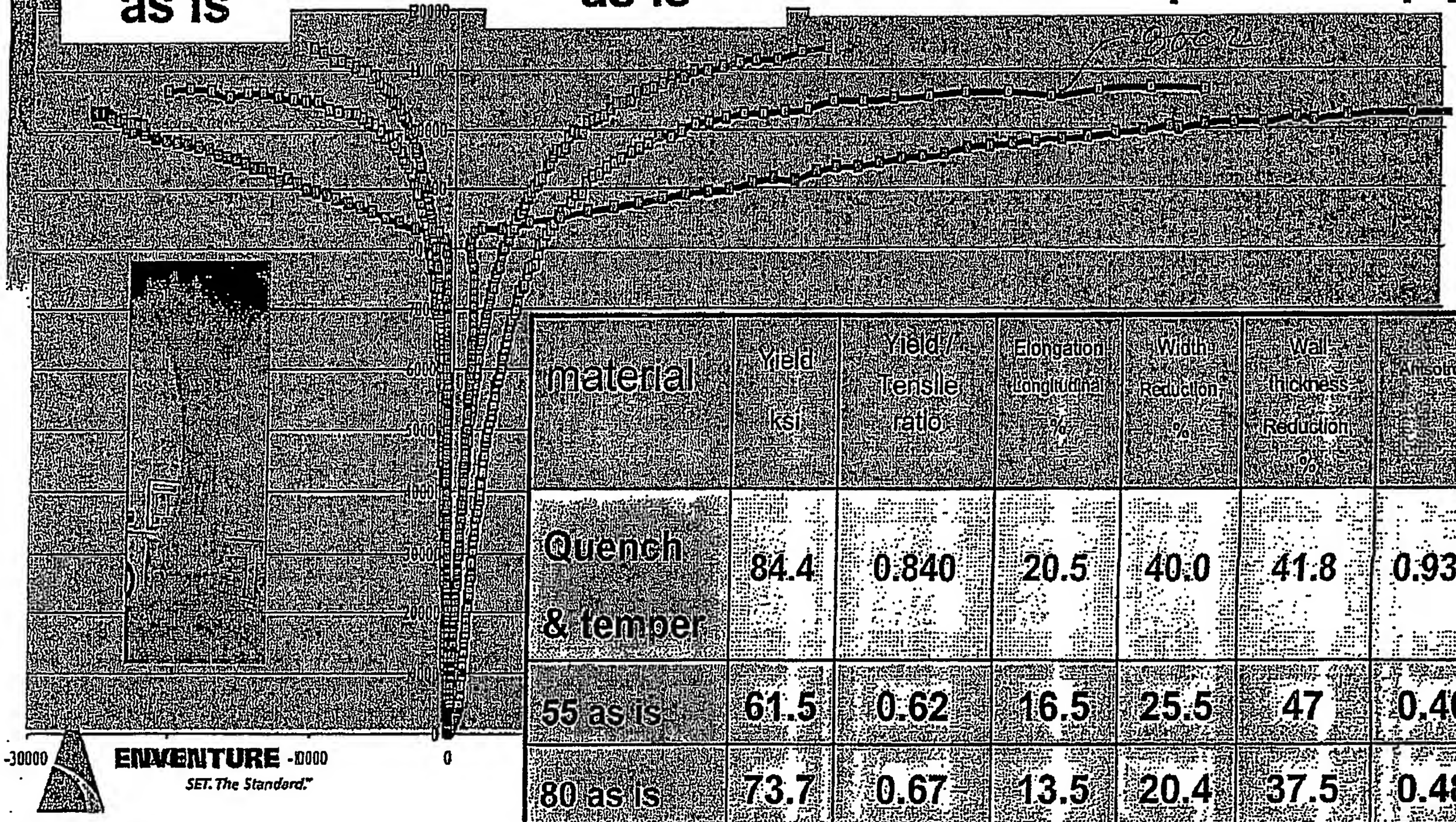
Engineering Stress vs. Strain Curve

(as received pipe vs. heat treated)

Pipe 7 " as is

Pipe 9 5/8 " as is

Quench & temper 9 5/8 'pipe



material	Yield ksi	Yield / Tensile ratio	Elongation (Longitudinal) %	Width Reduction %	Wall thickness Reduction %	Anisotropy
Quench & temper	84.4	0.840	20.5	40.0	41.8	0.935
55 as is	61.5	0.62	16.5	25.5	47	0.46
80 as is	73.7	0.67	13.5	20.4	37.5	0.48

FIGURE 80b

Bone Sample Formability Judgment

Sample	Yield	Y/U	Elongation	Width reduction	Wall thickness reduction	Anisotropy	Technology
8100							
40045	80.1	.72	35	35	33	.92	Hot stretch, reduced (1950°), rotary straightened
4-100	89.7	.88	25	22	20	1.1	Normalized (1850°), cold drawn, annealed (1050°), rotary straightened
8102 5-790	88.1	.87	16	24	30	.76	Hot stretch, reduced (1950°), cold drawn, annealed, rotary straightened
8104 40513	47.7	.73	38	43	49	.83	Hot stretch, reduced (1850°), rotary straightened
8106 40514	45.5	.69	40	50	53	.93	Hot reduced (1850°), cold sized, rotary straightened
8108 40241	52.7	.85	49	49	46	1.1	Hot stretch, reduced (1850°), rotary straightened
8110							

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FIGURE 81

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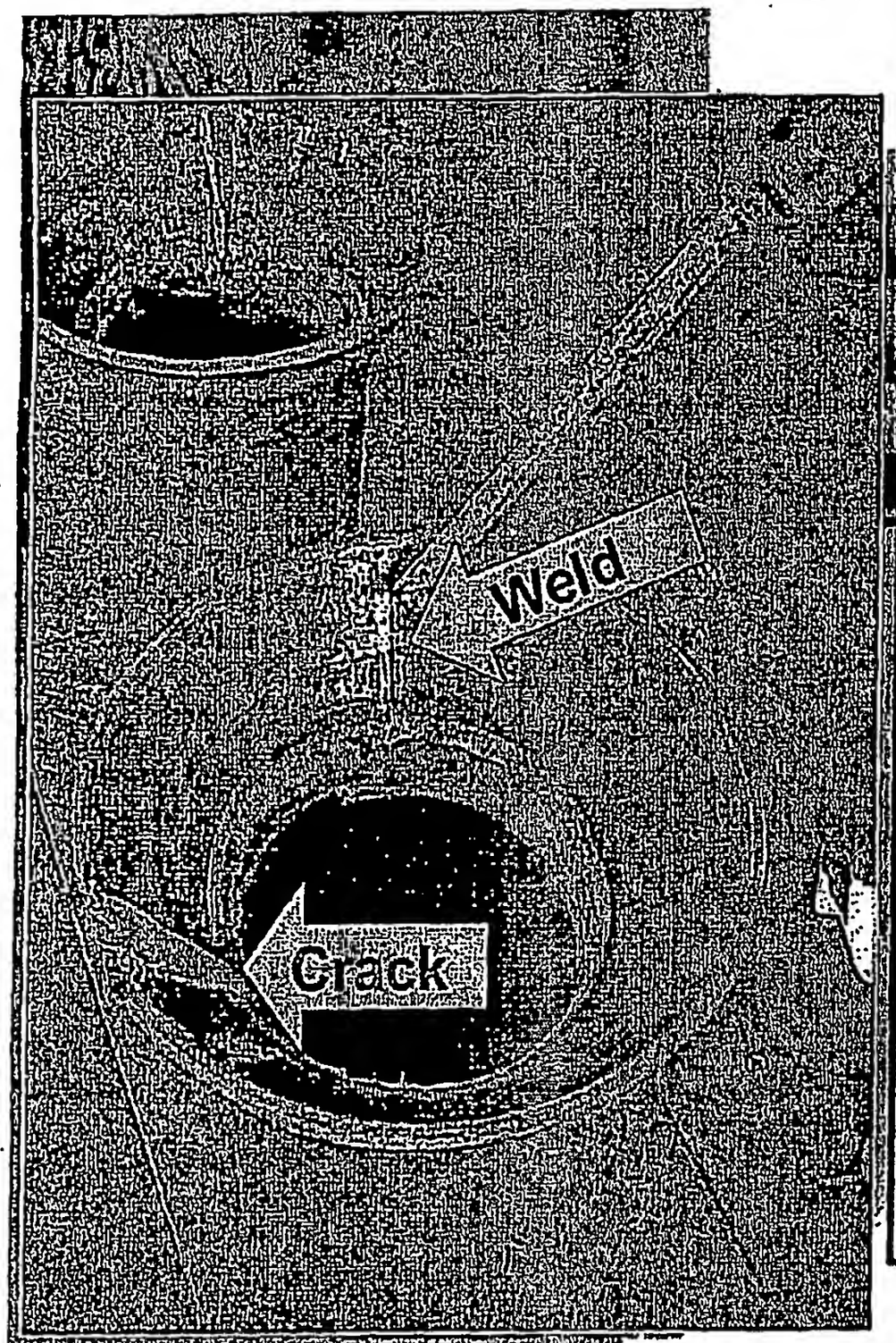
PCT/US2004/026345
95/96

Absorbed Energy and Flare Expansion Testing



material	Absorbed energy^ Longitudinal	Transverse	Weld	Flare expansion %
target	80	60	60	45
Quench & temper B200	125	59	176	42
Quench & temper B202	145	59	174	52
As is, 55 grade	100	40	70	32*
As is, 80 grade	50	30	4	30*

Quench& temper pipe, failure of pipe @ expansion load of 800000 & 1,200000 Lbs
*As received pipe, cracking in weld area
^ Measured at -4° F (-20° C)

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FIGURE 82

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